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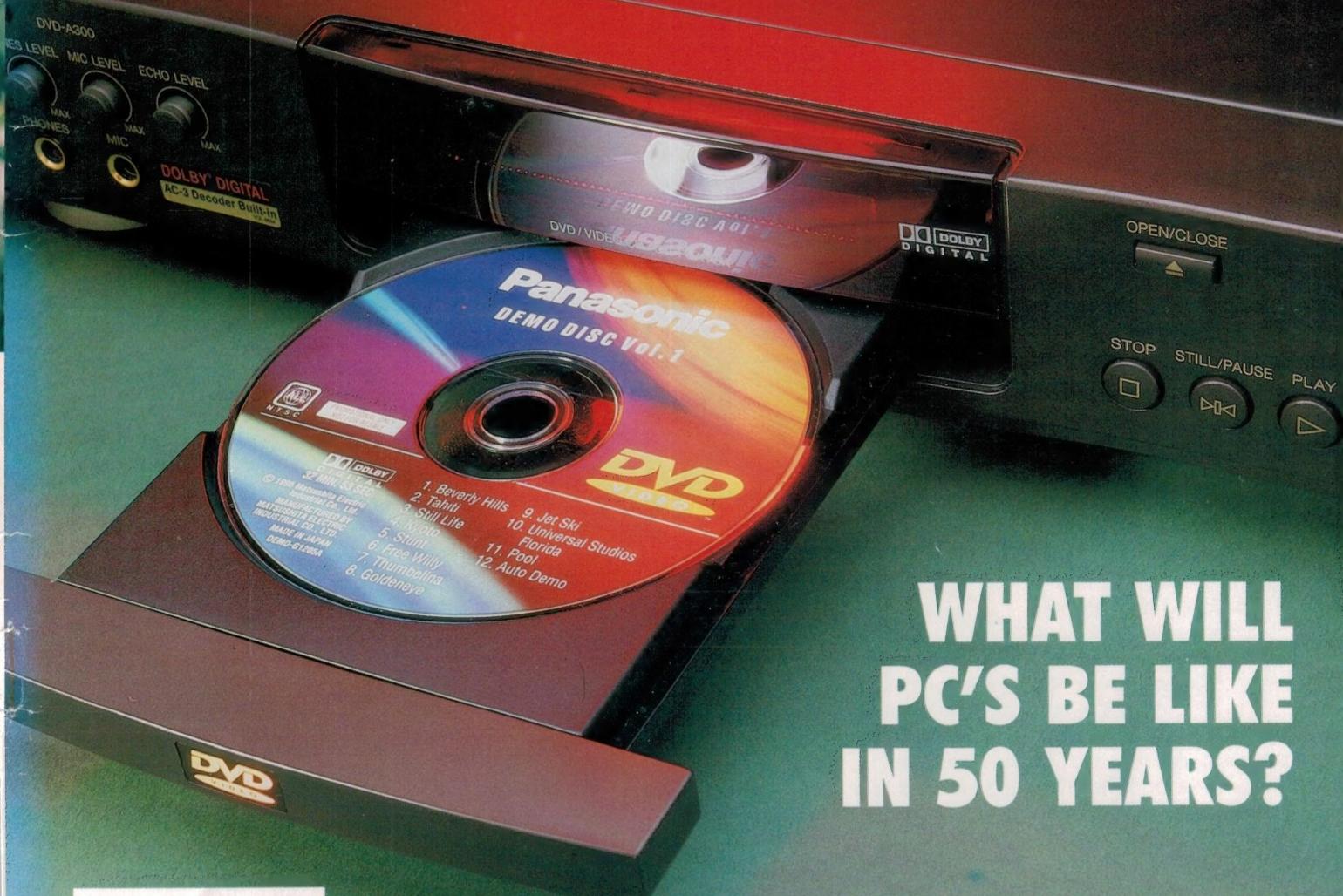
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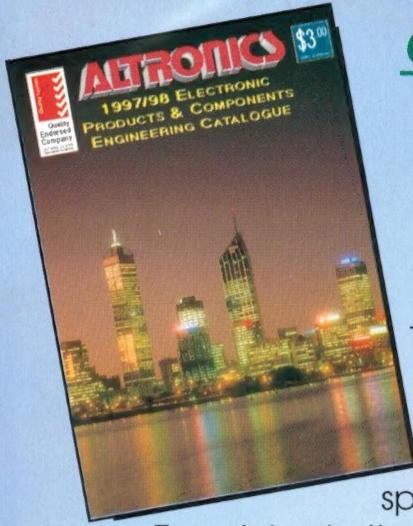
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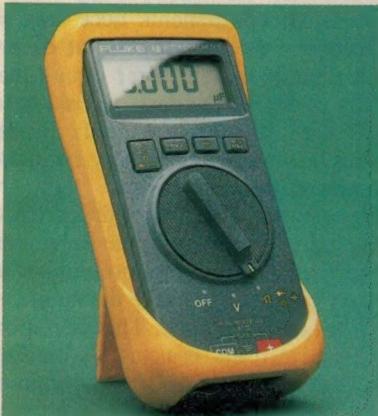
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Fluke's new model 18 multimeter is well priced, but at the same time capable of making an estimated 80% of the electrical measurements needed on modern cars. See page 70 for our review, and also how you can win one of these instruments — thanks to Dick Smith Electronics.

PIM reads 'graffiti'



US Robotics' novel Pilot 'personal information manager' accepts input in 'graffiti': an easy to learn shorthand. See our review on page 14...

On the cover

Panasonic had a sample of its new DVD A300 digital video disc player in Australia briefly, on its way through to the USA, and our reviewer Louis Challis was able to try it out on your behalf. Despite the shortage of software he was very impressed — see his review, starting on page 10. (Photo by Michael Pugh.)

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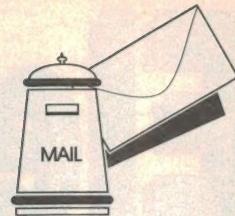
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LETTERS TO THE EDITOR

**Radar cameras**

Referring to Colin Jeffery's letter in Dec '96 'Letters' column, I wish to challenge Colin on the grounds of where is the evidence that speed cameras reduce accidents?

In NSW, police radar traps seem to position themselves down the bottom of a hill or just past a speed change sign, where you haven't even had time to slow down. When random breath testing started in this state, it had a sudden impact; but in recent times the number of drink-driving offences is on the increase, so one might argue — does it work?

Governments have invested big dollars in speed camera technology and obviously want to recover their costs, but will we find in a couple of years time that these did not solve the problem either (i.e., speed-related deaths)?

Nobody will argue that speed is not a factor in any accident, but here it's being treated as the only factor. So, are we getting to the root of the problem? Reducing speeds will result in more driver frustration and can aggravate things even more, believe me.

Another very important fact is that speed cameras are never seen on rainy days — why not? Surely on rainy days it is more dangerous to drive at any speed than on clear days, is it not? So why aren't they out there catching all those 'dangerous' drivers on rainy days?

Salvatore Sidoti,
Lilyfield, NSW.

Short form kits

I have just read the letter from E. Gordon Wormald in the February issue, and may be able to offer some advice (unprofessional, but from experience; I've been bitten too).

It is important to ask what the wording of the advertisement was. If the ad went along the lines of, or contained the wording 'Microprocessor controlled [whatever] short form kit' and contained no other information regarding the contents of the kit, then this ad is probably illegal under consumer legislation. Why? Because the claim of the advertisement is that the device is microprocessor controlled, but the actual kit

contains no such device. Price is not legally a *de facto* indicator of the contents of a kit.

Another question is, what makes a short form kit? The widely accepted definition is all components necessary to construct the *functional portion* of the circuit (that is, the bit of the circuit that actually performs the desired task, be it a PCB with all parts mounted). Power supplies, cases etc., are usually excluded from the definition, because they are largely generic. With the microprocessor excluded from the kit, the functional core of the kit is missing; no number of ancillary circuits will make the main circuit work *as advertised*. This is important: 'as advertised' is as legally binding as any other form of contract, written or verbal, and in this case the advertising states that the device is an ESR & Low Ohms Meter. Without the micro, the kit is in fact just a bunch of off-the-shelf components and a circuit board which, once constructed, will do three tenths of b-r all...

Of course, kits that are assembled incorrectly and thus fail to function are the constructor's problem, since the kit originally contained the potential to work correctly.

The point of all this is that when you advertise a kit, you sell the promise of functionality along with the physical components, tempered by the builder's ability. If the physical components do not match the promise, then advertising law has been broken. I would ask that Mr Wormald complain to consumer affairs, and take a positive step against dishonesty.

And we wonder why electronics retail and service has such a bad reputation.

Timothy Newsom
(Via fax.)

Camera cables

The article about camera cables in the January edition of EA was very interesting indeed, and to the uninitiated must have been quite an eye opener. However I must take the writer to task over the early historical information given. The early TV cameras were not as suggested self-contained units requiring only a single pair for AC power and a single coax

for camera video; they were in fact camera heads only, requiring horizontal scan current, vertical scan current, electrical focus, beam current adjust, blanking, AC, four different HT supplies, coms, tally and camera video.

The cable was manufactured for EMI by BICC in the UK, in various lengths up to 350 metres and used large connectors of the type employed on post-war cameras of the Marconi Mk3 type. It boasted no less than 26 conductors, with the scans, blanking, video and comms individually screened. Various lengths of cable could be joined to produce up to 470 metres of cable, however EMI only recommended using a maximum of 350 metres.

The time we are speaking about was 1936, and the TV station that of the BBC at Alexandra Palace in North London. The studio was equipped with three cameras, all fed from a single sync pulse generator to allow fading and supers to be performed — not bad for the time. Also one or two cameras were used in a teletype room for the televising of films, thus dismissing the notion that only live TV was possible. In fact television film scanners arrived before live pickup cameras for the production of high definition video signals (by high definition I mean 405 lines and above).

The reference to the early image orthicon camera is also quite wrong. The first camera tube to be used was in fact the Emitron, EMI's version of the American Iconoscope developed for RCA by V.K. Zworykin. The first cameras used in Australia certainly used image orthicons; vidicons and in one case a CPS (cathode potential stabilised) Emitron was used in a teletype chain.

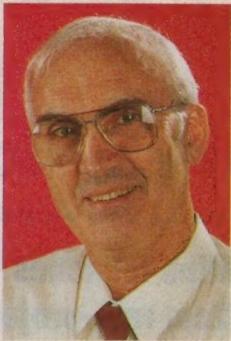
So there we have it; picky perhaps, but historically accurate. The case I have used as an example was the world's first public TV service, and to the best of my knowledge later systems only became more complex and required more conductors, until the evolution of triax.

Despite my attempt to correct reported history, I found the remainder of the article by Bryce Templeton informative. He succeeded in explaining a complex subject in a language suitable for all to understand — a job very well done.

Victor G. Barker, VK2BTV
Gorokan, NSW. ♦

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

EDITORIAL VIEWPOINT



The Pay TV schemozzle

As I sit down to write, the main players (and would-be players) in Australia's fledgling Pay TV industry are still locked in a series of fierce power struggles — largely behind the scenes. By the time you read this, we'll presumably have discovered who *did* win those battles, and therefore what we can expect for the next phase of the industry's stumbling development.

At the same time, we keep hearing stories about the disappointing subscriber levels for all of the operators, their significant losses and their high levels of 'churning' — the phenomenon of people subscribing, but then dropping off again after only a few months. There's also an ongoing battle between the Pay operators and many local councils, regarding the stringing of cables and other hardware down suburban streets. One gets the distinct feeling that whichever firms do win today's battles for control, there will still be many other battles ahead.

It's all quite a schemozzle, and I for one can't help believing that at least some of the mess has resulted from the refusal of successive federal governments to set up a properly planned and implemented single cable network infrastructure and 'common carrier' delivery system, whose facilities could then have been used by all service providers. This would have avoided all of the messy, costly and wasteful duplication of infrastructure by the service providers, and allowed them to concentrate their resources on providing the highest quality programming. It would also have ensured that we consumers were not faced with the prospect of multiple and mutually incompatible set-top boxes, if we want to receive programming from more than one provider — or take advantage of the other broadband and interactive services that are coming on the cables 'real soon now'.

As various people have pointed out, there are many areas of activity where competition can deliver clear benefits in terms of efficiency and lower costs — but others where the exact opposite is the case. There's no doubt in my mind that like the water supply and road systems, this is another situation where a single, standardised infrastructure should have been set up (probably at public expense), and the competition confined purely to the program and service provider area.

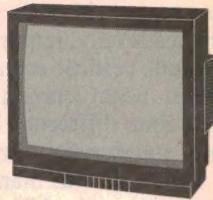
Whether it's now too late for this to be achieved, I don't know. I seem to recall that at least one of the antagonists in the current bloodbath has suggested that such a move would help resolve some of the problems, so perhaps there's still hope that commonsense will prevail. I suppose it all depends on just how deeply our current government is committed to the 'competition at all costs' ideology.

Inevitably, it's we viewers and users of tomorrow's broadband services who will end up paying for all of the waste and duplication, one way or another. I don't know about you, but I'd rather be paying to develop an asset that we all end up owning, rather than simply boosting the coffers of a media mogul or two — and probably moguls who live overseas, at that.

Jim Rowe

WHAT'S NEW

IN THE EVER-CHANGING WORLD OF ELECTRONICS



Philips launches 'Megavision' 122cm rear-projection CTV



US Robotics sets up in Australia

US Robotics, one of the leading US suppliers of modems and other data communications products, has just set up an Australian operation. The company has around 25% of the market for PC modems in the USA, and its arrival here is expected to really enhance competition in the Australian market.

The head office is at 473-479 Victoria Street, West Melbourne 3003; phone (03) 9482 6557. There's also a Sydney office at Level 9, Suite 8, 100 Walker Street, North Sydney 2060; phone (02) 9926 1260. The company's Web site is at <http://wwwusr.com>.

Big-screen rear projection TV receivers have been big in the USA for quite a while, but they've only recently started to become popular with Australians — as part of the growing interest in 'home cinema' and surround sound systems.

Partly, the slow growth here has been due to very high price tags. Estimated sales last year for big-screen sets in Australia were only 2000 units, according to Philips, compared with 887,097 in the USA.

Philips is in a good position to take advantage of the growing interest in home cinema and projection TV, by virtue of the design and manufacturing experience gained by its US affiliate Philips Magnavox. As a result, the company is now launching a new large-screen PTV (projection TV) designed to deliver high performance but at a more 'affordable' price level.

Known as the Philips Megavision 48P977, the set features a huge 122cm (48") screen and multi-mode home cinema sound. With an RRP of \$5999, it costs about half that of other models currently on the market.

The Megavision incorporates key features from Philips' premium Matchline TVs enhanced by the latest optical projection technology. Features include high brightness, wide horizontal viewing angle (160°), digital convergence and an 'Incredible Picture' auto picture quality system, while a two tuner picture-in-picture (PIP) facility allows you to monitor one broadcast or video source while watching another.

The set also has four built-in speakers with separate woofers and tweeters, to achieve high quality sound — with a simulated surround sound function for impressive 'home cinema' ambiance without the need for wires and additional speakers.

Philips is offering free delivery and installation directly into the consumer's home in most areas. A trained Philips technician will connect the projection TV to all existing equipment and provide a product demonstration.

Philips' Megavision is available at Myer/Grace Bros, David Jones, Brashs, Chandlers, Harvey Norman, Vox, selected Retravision and Betta stores and selected specialists nationally.



US novelty phone manufacturer Telemانيا, based in a suburb of New York with the improbable name of Ronkonkoma, released this new Coca Cola phone at the recent Consumer Electronics Show in Las Vegas. When there's an incoming call a circular sign inside it pulsates, while the phone plays a Coca Cola jingle...

Panasonic mini hifi systems

Panasonic has added three new mini hifi systems to its range, all with a five-disc CD changer.

The highest featured of the three models is the SC-CH75, which has a powerful output of 2 x 90 watts (RMS) and an 'airport-like' spectrum analyser display. Its 13-band spectrum analyser is represented by a pulsating light pattern which resembles an airport runway at night. There is a choice of Normal, Aurora, Peak Hold or Demo mode, three preset equaliser patterns (Heavy, Clear, Soft) and three sound field controls (Disco, Hall and Live). These can be overridden to make adjustments to suit

individual tastes.

The five disc 'stacker-style' CD changer used in the new models uses Panasonic's 'Digital Servo' plus MASH single-bit DAC technology to ensure high sound quality and reproduction. Panasonic has also developed a new Dynamic Damper Speaker design, which is claimed to provide better bass and minimal distortion during musical peaks.

The second model in the range, the SC-CH74 has 2 x 50W (RMS) output while the last model, the SC-CH34 has 2 x 30W RMS.

The SC-CH75 and SC-CH74 have a full function remote control, while the SC-

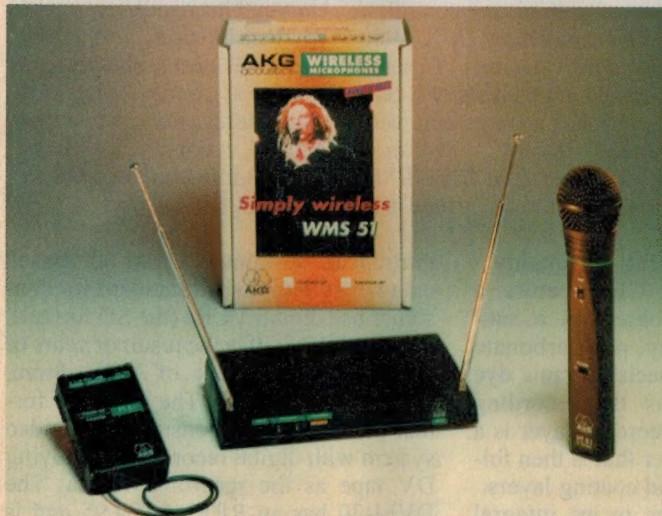


CH34 remote has fewer tape control functions.

The new Panasonic mini hifi systems are available from leading electrical retailers. The RRP's are

\$659 for the SC-CH34, \$769 for the SC-CH74 and \$999 for the SC-CH75. For further information contact Panasonic's Customer Care Centre on 132 600.

'Plug & Play' wireless microphone from AKG



Austrian firm AKG, famous for its microphones and headphones, is now offering a 'plug 'n play' wireless microphone system which is claimed to be extremely easy to set up and use on speech, vocals and instruments. It's also claimed to provide outstanding value for money.

Operating the WMS 51 is said to be a breeze even for less experienced users. It operates on 12 different frequencies, and all frequencies are colour coded for easy identification and matching.

The SR 51 diversity receiver ensures reliable, dropout free reception as it uses two anten-

nas and automatically selects the signal with the better signal to noise ratio. A special strain relief prevents the power supply cable from being disconnected accidentally, while a squelch circuit suppresses RF noise. An XLR output allows the SR 51 to be connected directly to a mixing console.

The ergonomically shaped HT 51 handheld transmitter uses one of AKG's D 3700 microphone elements and provides a powerful sound for both speech and vocals. A hypercardioid polar pattern ensures extremely high gain before feedback and excellent separation. A transducer



In the ever-accelerating move towards digital technology, the humble dictation machine hasn't been forgotten. Grundig's new GDV 4030 has no moving parts and records up to 20 minutes of dictation on a two-megabyte memory card.

shock mount compensates for handling noise.

The PF 51 bodypack transmitter can be used with any MicroMic II Series micro-

phones, which makes it the ideal choice for speech, vocal, and instrument miking.

The WMS 51 is available now from AKG dealers.

Affordable Home Cinema, and without the hassles

Many people find the idea of Dolby Pro Logic 'surround sound' appealing, and would like to turn their home TV into a real home cinema — but are put off by the technical complexity and the need to 'mess around with all those bits and pieces'. If you're in that position, Philips may just have the answer for you: a complete Dolby Pro Logic upgrade pack that simply connects to your existing TV and hifi system to give you a full Pro Logic system, and thus a whole new dimension in home entertainment.

The new Philips AV900 Dolby Pro Logic upgrade pack combines a stereo hifi video cassette recorder with a set of speakers featuring a built-in Dolby Pro Logic processor and centre channel/surround channel amplifiers — all housed in three compact and elegant cabinets. Providing your existing amplifier has



auxiliary input connectors, the AV900 upgrade pack can turn it into a high performance Prologic system.

Philips claims to be the first company to bring such a combined VCR/Dolby Pro Logic speaker upgrade pack into Australia.

The VCR in the upgrade pack is Philips' VR656, a high quality six-head Turbo Drive unit which offers G-Code programming, hifi stereo sound

(including decoding of Zweiton stereo, as transmitted by Australian TV stations), PAL or NTSC recording and playback, wide screen playback capability and 'Incredible Picture' auto picture control.

The matching MX 900 ProLogic Home Cinema Upgrade Kit consists of a centre channel speaker unit with inbuilt Dolby ProLogic decoder and 2 x 25W RMS amplifiers for the centre and

surround channels (including a 20ms surround channel delay, for greater realism), and line outputs for main, surround and external subwoofer amps; a pair of surround channel speakers; and a 22-key full function remote control.

Anthony Toope, senior product manager for Philips Sound & Vision, claims that with its RRP of only \$1099, the AV900 Pro Logic Upgrade Pack is not just an easy way to create home cinema, but it is terrific value. The MX 900 upgrade kit is also available without the VCR, for an RRP of only \$499.

The pack and kit will be available from June from Myer/Grace Bros, David Jones, Brashs, Chandlers, Harvey Norman, Vox, selected Retravision and Betta Electrical stores, and selected specialist home entertainment stores. For more information, contact Philips' Customer Information Centre on 13 13 91.

Recordable CD, mini DV cassette from TDK



Recording media supplier TDK has announced its latest recordable CD, the CD-RXG74. Designed primarily for recording music, the CDRXG74 disc has been engineered specifically for home recording and meets the same exacting quality standards as their professional multimedia CD-Rs.

With a home CD-R recorder, users can now transfer music from either an analog or digital source onto a CD-RXG disc that can be played on any conven-

tional CD player, with full CD quality.

The new CDRXG CDs feature a multi-layer structure based on a substrate of high quality polycarbonate resin, coated with a special organic dye solution, which forms the recording layer. On top of the recording layer is a gold leaf reflective layer that is then followed by protective and coating layers.

The reflective layer is an integral part of the performance of the CD-RXG. This gold reflective layer reflects over 65% of the laser beam, making certain reliable playback is possible even with many of today's low-powered laser pickups.

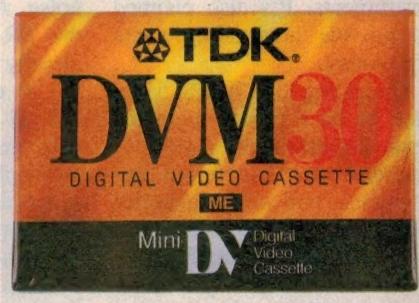
To ensure excellent optical and mechanical characteristics the injection molding that forms the shape of the disc is performed under the most exacting conditions. The result is that TDK claims its CD-RXG discs exhibit exceptionally low error rates across the entire surface of the disc.

TDK's CD-RXG recordable CDs are available in both 74- and 60-minute playing times and come with a lifetime warranty.

TDK has also added a 30-minute tape to its digital video cassette (DVC) range, following the success of its recently

introduced 60-minute DVM-60. Based on a newly established standard for consumer use digital VCRs (the SD format), the new DVM-30 is the result of years of ongoing development of VHS, 8mm, SVHS, and Hi8 tape. The Mini DV format offers the first, consumer-use video system with digital recording employing DV tape as the recording media. The DVM-30 has an RRP of \$29.95 and is available at selected TDK dealers.

For further information on either the CD-RXG recordable CDs or DVC cassettes contact TDK on (02) 9437 5100.



New portable GPS receivers



Thanks to the global positioning system (GPS) and its orbiting Navstar satellites, no-one need get lost again providing they have a GPS receiver and can 'see' a reasonable amount of clear sky. And the performance of Magellan's range handheld GPS receivers has just been enhanced, with the release of

their new 'XL' models: the GPS 2000XL, GPS 3000XL and GPS 4000XL.

Among the features of the new models are wrap-around rubber armouring and a dry nitrogen-filled waterproof case, for added ruggedness and reliability. The XL range also boasts Magellan's proprietary 'AllView 12' technology, which tracks up to 12 satellites for added accuracy, and what is claimed at the most sensitive built-in antenna of any GPS receiver of this size.

Another feature is lower battery consumption — the receivers will run continuously for 24 hours, on four AA alkaline cells.

The GPS 2000XL has EZ-start initialisation, which eliminates the need to key in coordinates when using it for the first time. The 3000XL adds the ability to upload/download navigation data from a PC, while the 4000XL adds map projection and triangulation features — plus the ability to calculate sunrise/sunset times and moon phases for any location. The 3000XL and 4000XL are also 'differential ready', and when linked to a DBR or similar device can give accuracy to within 5 - 10 metres.

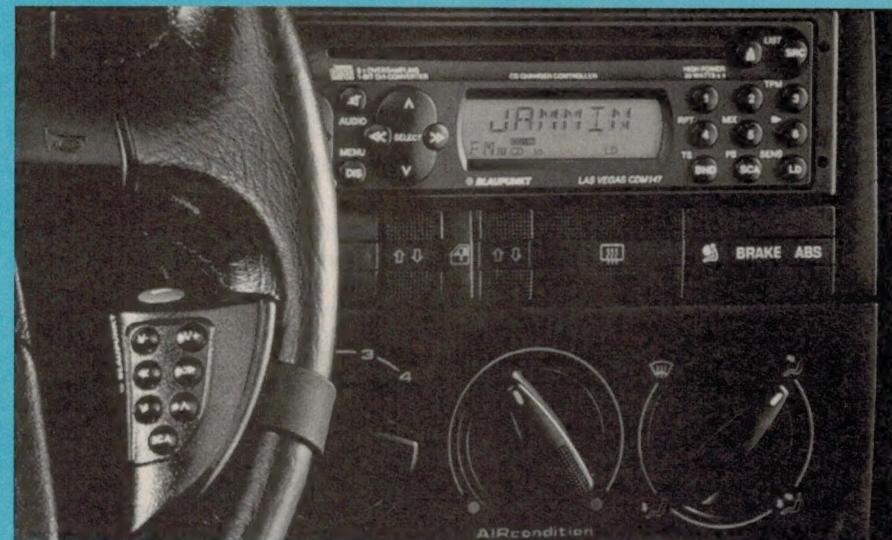
Safer control of car audio systems

There's a growing awareness around the world that many accidents on the road are caused by drivers being distracted — by such activities as using a mobile phone, or adjusting their vehicle's radio or audio system.

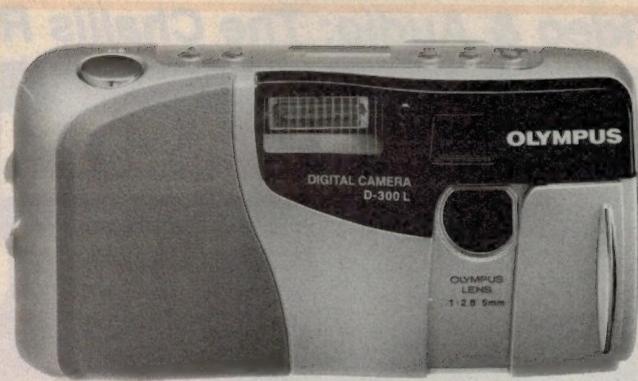
Now German manufacturer Blaupunkt (part of the Bosch Group) has come up with a device they believe will help make it safer for car drivers to adjust their audio system: the 'Thummer', a remote control device which mounts directly on the steering wheel. This allows control of many of the company's in-dash car stereos, CD receivers and a 10-disc CD changer, without taking your hands off the wheel at all.

The device is now available in

Australia, with an RRP of \$149. For further information contact Robert Bosch (Australia), PO Box 66,



Clayton South MDC, Clayton 3169; phone (03) 9541 5555 or fax (03) 9543 4293.



Higher resolution digital camera

Digital still camera technology is moving ahead in leaps and bounds in 1997. This new D-300L model from Olympus provides the highest image resolution in its class — 1024 x 768 pixels — plus autofocus, a choice of either optical or LCD viewfinder, and storage of up to 120 images. It's selling for around \$900 in the USA.

Pocket phone/PIM has Web access too

Want to surf the Web or send an e-mail back to the office, while you're sitting in a park in downtown San Francisco? Japan's Toshiba Corporation has announced a product that will let you do just that. The new Genio PCV100 is a pocket-sized 'mobile communicator' which combines a Personal Handyphone System (PHS) cellular phone with a pen-driven personal information manager (PIM), and also a data modem which allows you to access the Internet and World Wide Web directly. It went on sale in Japan on April 25.

The Genio weighs only 220 grams, has an 88mm liquid-crystal screen and takes removable 2MB memory cards. The rechargeable lithium ion battery can provide up to 150 minutes of continuous on-line communications. The inbuilt 32kb/s modem is coupled to both a Web browser and an e-mail program which supports MIME encoding of graphics, etc. ♦

PANASONIC'S DVD A300 VIDEO DISC PLAYER



Very soon after reviewer Louis Challis had filed last month's review of one of the new DVD players, he had the opportunity to preview another: the Panasonic DVD A300, now in full production. It was a sample made for the US market (hence only capable of playing discs made for that 'region'), but it gave him a good taste of what we're likely to see and hear in Australia 'really soon now'...

The Samsung Model 860 DVD player which I reviewed last month was a pre-production model. Although its performance and functionality was exciting (as it was the first off the rank), it obviously could not incorporate all the features that an American, Japanese or even a Korean consumer would expect to find in subsequent final production models.

As fate would have it, two weeks later Panasonic Australia offered me the opportunity to evaluate a full production version of its acclaimed DVD A300 Player. The remainder of that production batch were apparently immediately shipped to America, where by now they sit on various shelves in shops all over the country (or perhaps are already in customers' homes).

Unlike the Samsung player which had no handbook, and thus left me to my own resources, the DVD A300 Player came complete with an excellent handbook. Although intended for the US market, that handbook has instructions in English, Spanish and French. For the first time it provided me with answers to loads of critical questions which I posed in order to extract the optimum benefit from this exciting piece of equipment.

In the same week, my younger son drew my attention to recent moves in the computer industry, of which I had been unaware. He told me that IBM, Apple, Motorola, DayStar Digital and a small but select band of other computer manufacturers were already wrestling with the

concept of integrating combined CD ROM/DVD players into their next generation of computers.

There is one fundamental problem with following that option. Computer-based DVD players are likely to be more expensive than the 'soft option' of purchasing a consumer based DVD player. If your reason for buying a DVD player will be primarily to watch movies, then that has to be the way to go.

When I opened the DVD A300's carton, I found a product packaged ready for the market. It came complete with handbook, a multi-function remote control and a single interconnecting cable incorporating two colour coded audio leads and one colour coded video coaxial lead. Whilst

Panasonic Australia provided additional leads to assist me with the player's integration into a home video or theatre system, it is my understanding that the US purchaser will only receive a single audio/video interconnection cable.

An examination of the front panel of the DVD A300 player reveals it has relatively few controls. Of course there's a good reason for that. The real power and multi-functional control capability is achieved through the use of its new generation remote control.

The left-hand side of the front panel has the following controls: a power ON/OFF switch, a headphones socket and volume control potentiometer, a microphone socket and level control potentiometer, and lastly an 'Echo level' control potentiometer. The last three are intended to be used with Karaoke DVD's, which the Japanese have foreshadowed releasing on both the Japanese and US markets.

The centre of the front panel incorporates a neat and effective display which advises whether the disc being played is a previous generation video CD, a DVD or an audio CD. It also indicates the title number for DVD only, and the chapter or track number for both DVDs and CDs.

The display shows what type of disc has been loaded, and also provides a range of warning messages. Thus a warning is displayed if the disc tray is open, being closed or has no disc. Most importantly of all, it provides a warning where the disc cannot be played because you have inhibited that disc or class of disc from being played by your children.

Last but by no means least, it will also indicate 'NO PLAY' if the disc is intended for a different region or area of the world (i.e., China, Japan or Europe).

On the right-hand side of the front panel, buttons are provided for OPEN/CLOSE, STOP, STILL/PAUSE and PLAY. In addition, pushbuttons are provided for SKIP FORWARD and SKIP REVERSE. A large knob is provided for low and high speed forward and reverse search modes.

On the rear panel coaxial sockets are provided for the video out, two primary audio output channels (suitable for a TV), together with the normal 5.1 channels of Dolby Digital output. (Left and right, front and rear, centre and the '0.1' subwoofer channel covering 10Hz to 120Hz). An S-Video output socket is also provided, affording a simple means of interconnecting a TV set or video recorder to the DVD player's combined two channel audio and video output.

At the extreme right-hand side of the rear panel a white adhesive label stated in the simplest of terms that this DVD Player was only suitable for 'Locale 1' (i.e., the USA and Canada). Of course that label immediately caught my attention. By that stage I understood exactly what it meant — namely, that if I had software from any other region, I would be unable to play it. The decision to incorporate that function was only resolved late in 1996, so

MEASURED PERFORMANCE OF PANASONIC DVD A300 PLAYER

Serial No. K6GA 00074

1. FREQUENCY RESPONSE

5Hz to 22.05kHz +/-0.8dB

2. LINEARITY

Nominal Level

dB	Measured Output L Channel, dB	Measured Output R Channel, dB
0	0	0
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-20.0
-30.0	-30.0	-30.0
-40.0	-40.0	-40.0
-50.0	-50.0	-50.0
-60.0	-60.0	-60.1
-70.0	-70.1	-70.1
-80.0	-80.3	-80.4
-90.0	-89.5	-89.5

3. CHANNEL SEPARATION

Frequency	Right Into Left, dB	Left Into Right, dB
100Hz	-115.2	+120.2
1kHz	-106.9	-107.3
10kHz	-86.9	-70.0
20kHz	-78.4	-62.8

4. DISTORTION

(at 1kHz)

Level	2nd Harm.	3rd Harm.	4th Harm.	5th Harm.	THD%
0	-89.1	-94.9	-95.8	-99.9	0.0041
-1.0	-88.4	-94.9	-94.7	-100.2	0.0048
-3.0	-89.1	-94.4	-94.3	-99.7	0.0023
-6.0	-89.9	-95.8	-93.3	-99.5	0.0032
-10	-91.9	-94.4	-95.8	-101.0	0.0038
-20	-96.9	-98.9	-96.3	-99.3	0.0021
-30	-90.7	-84.5	-92.1	-93.8	0.0072
-40	-80.2	-75.9	-79.3	-76.9	0.028
-50	-71.9	-68.7	-72.0	-69.3	0.067
-60	-61.4	-51.8	-60.3	-58.5	0.16
-70	-34.7	-34.5	-41.1	-42.2	2.8
-80	-37.6	-31.2	-41.1	-32.9	3.1
-90	-36.6	-30.1*	-28.5*	-15.1*	19.9

*Noise dominating measured result

(at 100Hz)

	-92.1	-95.8	-102.8	-104.4	0.0024
-20	-100.0	-104.9	—	-107.3	0.0013
-40	—	—	—	-90.4	0.0033
-60	-67.1	-70.5	-72.4	-73.6	0.065
(at 6.3kHz)					0.0016
0	-98.6	-102.5	—	—	

5. EMPHASIS

Test Frequency

	Recorded Test Level	Measured Output L	Measured Output R
1kHz	-0.37dB	-0.4	-0.3
5kHz	-4.53dB	-4.2	-4.2
10kHz	-9.0dB	-8.5	-8.5

6. SIGNAL TO NOISE RATIO

Track

23 Without Emphasis	-103.7dB (Lin)	-107.0dB (A)
24 With Emphasis	-103.8dB (Lin)	-107.2dB (A)

7. FREQUENCY ACCURACY

Test Signal

Output Measured

8. DIRTY RECORD TEST

Interruption in Information Layer

9. BLACK DOT AT READ OUT SIDE

10. BLACK STRIPE TEST

Passed all levels

Passed all levels

Passed all levels (including 2.5mm)

Panasonic really must have moved very expeditiously to incorporate the appropriate controls in their internal software to provide this function.

Brash's Australia had been kind enough to lend me a new DVD movie disc featuring Arnold Schwarzenegger in *Eraser*. My son had already primed me that it wasn't neces-

sarily the kind of film that I would automatically like, but it was most certainly the type of film which he would like. So I loaded the disc — but wasn't really surprised when the DVD Player's front panel correctly advised me NO PLAY, as their software and hardware were deliberately incompatible.

At that stage I decided to embark on test-

ing the player's performance, in as thorough and objective a manner as possible.

Testing, testing

Although Toshiba, Sony, Philips, Matsushita, JVC and the other major players have been developing formal DVD test discs, at this point of time none of those discs have been released for use in the USA, let alone Australia.

Faced yet again with that time-honoured problem, I selected the 12 most relevant CD test discs which I routinely use, and proceeded to put the DVD A300 player through its paces, albeit as an audio CD player.

As you will see from the attached table of test results, its performance as a CD player is exemplary. The frequency response graph displays an almost 'ruler flat' response between 5Hz and 2kHz, then a gentle rise between 2kHz and 22kHz — rising by a modest 0.8dB at the upper end of the frequency range.

(Incidentally the Samsung DVD player exhibited a similar characteristic. On the basis of only two tests, I have a sneaking suspicion that there may be a good reason for both manufacturers to opt for a gently rising response of that type, instead of aiming for the more classical 'ruler flat' response.)

The 'fade to noise' test was the next aspect I investigated. The DVD A300's overall 'fade to noise' linearity over the critical -60dB to -110dB range correlates well with the results of the conventional linearity test at discrete increments of -10dB. The magnitude or degree of non-linearity exhibited is particularly low, and typifies the 'better to best' performance that I have seen to date.

Even at -110dB, the degree of curvature displayed is only really representative of the noise threshold rather than being the result of inherent digital to analog nonlinearity. Three to five years ago, you or I

would have expected to pay between \$1500 and \$7000 for a CD player offering that class of performance...

I progressed with channel separation measurements, and found that they were exemplary. I couldn't find any fault in the distortion measurements either, which don't become significant until you get to signals which are below -60dB.

Although the level of distortion starts rising rapidly in the vicinity of -70dB and below, those distortion components still fall within the region of what I would describe as being inaudible — except for the special case where you 'glue your ear' to the loudspeaker and are prepared to turn up the level of amplitude during soft passages, in order to identify the audible distortion.

The compliance with the emphasis characteristics was good (better than most), whilst the measured 'signal to noise ratio' performance — both with and without emphasis being applied — was exemplary. The only parameter which appeared to be marginally lower than what would be described as conforming to a 'five star rating' was the frequency accuracy, which was a modest 3.5Hz high. But that amount of frequency inaccuracy shouldn't trouble anybody.

The last series of objective tests that I applied were those involving 'interruption in the information layer' — the 'black dot test' on the readout side, and the 'black stripe' tests which traditionally separate the good CD players from those that are only reasonable.

Once again, I simply couldn't fault the DVD A300 player's performance on any of those tests. Indeed, I wasn't surprised to find that it could track a 'black stripe' which was all of 2.5mm wide, with absolutely no trace of audible hiccups or other identifiable forms of distress.

In the absence of a formal DVD objective test disc, and fearing the recriminations that would result from an attempt by

me to 'doctor' the three discs which had been lent to me, I resisted the temptation to apply my own 'black stripe' test strips to them. Instead, I chose to relate the test data derived with the Sony-CBS 'black stripe' CD test disc, and to interpolate those test results into a prospective performance with a DVD test format. I estimate that the DVD A300 player would potentially cope with a 200um wide 'black stripe' before it would exhibit any disability in terms of picture quality or sound.

Trying it out

At that point, I set aside my CD test discs, packed up the DVD A300 player and travelled homeward to evaluate the three DVD demonstration discs which Panasonic had provided.

I interconnected the DVD A300 with a brand new Samsung model CS-721 APF 'Worlds Best Plus' (29 + 1)" TV set, which has just been released on the Australian market. The combination of the Panasonic DVD A300 player with a Samsung CS-721 APF TV set, supplementary amplifiers and speakers constitutes an extremely potent home theatre system. Frankly, having put it through its paces, I would be happy to own such a system.

The DVD A300 player provides the ability to opt for a standard 4:3 picture aspect ratio, a reduced width 'pan and scan' video picture or a 16:9 'letterbox' wide screen option. The Samsung CS-721 APF TV set provides the same range of functions, which means that you can get compounding of the multiple functions if that takes your fancy (although in my case it didn't).

I soon discovered that the DVD A300 player provides an exceptional picture quality, even when allowing for its fundamental NTSC format. That format is of course inferior to the 625-line PAL standard with which we have all become reconciled, at least in terms of image resolution.

Two of the three discs which Panasonic provided were specially recorded as demo discs in Japan. The third disc is a full length concert featuring 'Chic Live in Japan', recorded in 1996. Whilst that disc undoubtedly typifies what Japanese consumers are currently purchasing, it falls well short of either the video or audio quality standards exemplified by the two demonstration discs.

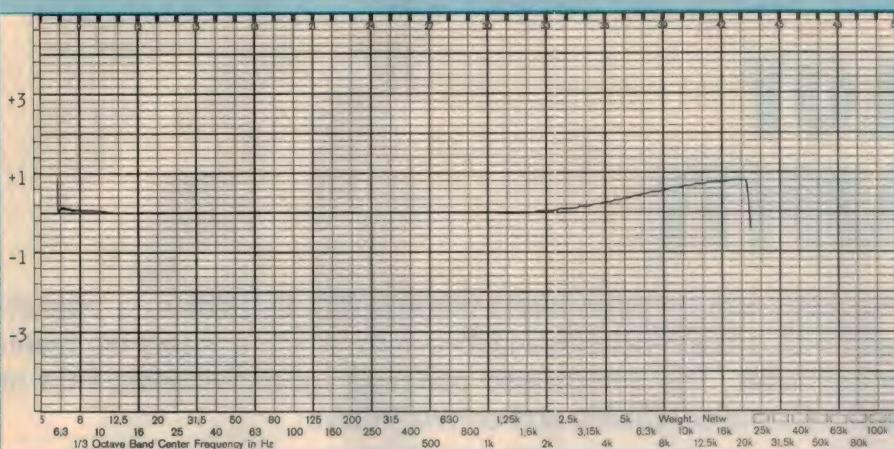
The most recently produced of the demo discs was entitled 'Demo Vol. 1'. It contained promotional extracts from *Free Willy*, *Thumbelina* and a memorable extract from the start of *GoldenEye*, which is an absolutely stunning example of cinematography.

The availability of a large screen TV, excellent sound system and appropriately illuminated room seduced me (and the rest of my family) into thinking that we were in a cinema. If I had needed any further convincing that DVD will be the future wave, by the time I finished viewing

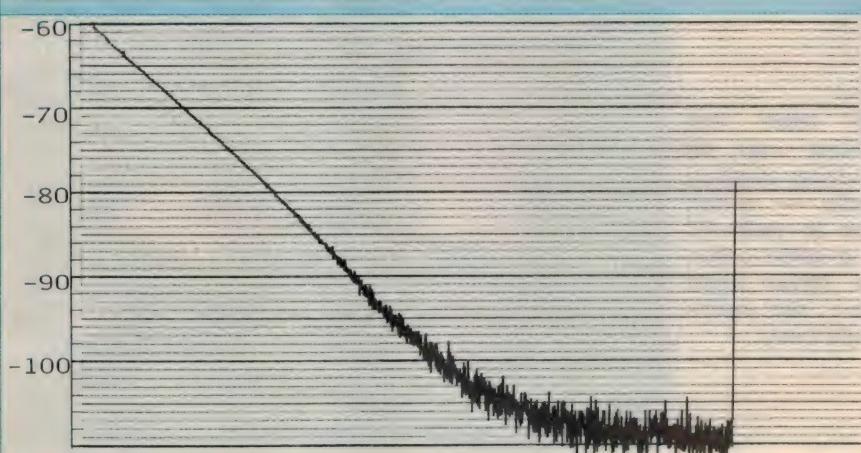


Clearly visible on the rear panel of the preview sample DVD A300 was a 'Locale #1' label, indicating that it was intended for the North American area. Predictably, it wouldn't play discs made for other areas.

PANASONIC DVD A300 — FREQUENCY RESPONSE — LEFT CHANNEL



PANASONIC DVD A300 — FADE TO NOISE TEST — LEFT CHANNEL



Quite apart from its ability to play the new digital video discs, the DVD A300 turned out to be an excellent audio CD player. The response has a gentle rise to +0.8dB at 22kHz, as you can see, while the fade to noise performance below -60dB is particularly linear.

the demo discs, I was sold on the concept.

It didn't take long to discover that the DVD A300 player also provided a whole host of new and exciting functions which I hadn't known were there. These included the ability to display on the TV set screen information on the title, chapter, time, and subtitles (in the four languages offered by the demo disc). In addition, I could add markers to which I could return at will; change the language at the click of a button; view three different picture filming angles (where offered); select heading titles (where offered); and most critically, set the rating level to which my grandchildren had access without parental control.

The three ratings offered are 'Kids Titles Only', 'Forbid Adult Titles' and 'Play All Titles'. Not only that, I could set in a four-digit password which would ensure that the children couldn't unlock the DVD player without my approval...

After whetting my appetite with all the exciting controls, my only complaint is that the DVD software provided lacked the continuity and cumulative impact that only a full-length DVD movie disc can provide.

It was at that stage that I set aside the

demo discs, and loaded a series of conventional CDs to assess the musicality of the sound system which I had set up specifically for evaluating DVD.

The first disc I played was 'Appalachia Waltz', featuring Yo-Yo Ma, Edgar Meyer and Mark O'Connor, in a relatively modern rendition of American traditional music. (Sony Classics SK68460). Whilst it is different, it still provides an excellent test vehicle for evaluating a CD-based sound system with carefully selected and adjusted speakers. With my eyes closed, I could easily imagine that the three great musicians were with me in the same room.

The second disc I used features the original motion picture soundtrack from the film Hamlet (Sony SK62857). Track 1 of that disc features Placido Domingo singing a number called 'In Pace'. His voice backed by the orchestra provided an excellent basis for once again evaluating other critical characteristics in the system. As I played that particular track, I must admit I was impressed by the performance of the overall system, which was enhanced by the five separate channels of sound amplification.

As a conventional CD player the DVD

A300 is clearly 'Grade A'. I feel that there is not very much to be gained by opting for the purchase of a better or more expensive CD player when this DVD player provides a double capability — for what would appear to be the same or a lower price.

By the time those thoughts passed through my head, it was late on a Saturday afternoon, and had I promised to return the system on the Monday morning. I realised that I still hankered for the opportunity to see just how well the DVD A300 player performed on real movie software.

I rang the Manager at Brash's Sydney store, grabbed the Eraser disc which he had been kind enough to lend me, and drove to the city. As I arrived, Brash's was closing. I loaded Eraser into their Panasonic A100 demonstration DVD player. Of course there were significant differences between this DVD player (which is currently only available in Japan) and the technically advanced DVD A300 player which I had been evaluating, but never mind...

I spent more than an hour in Brash's store, which was quiet following the departure of both public and staff. I was able to view and audition a series of selected segments from the Eraser disc, using Brash's demonstration system. Fortunately the DVD A300's remote control (which was fortuitously labelled in English, unlike Brash's own remote control) also provided complete control over their DVD A100 player.

Brash's DVD demonstration system employed an excellent (and expensive) Panasonic 16:9 format monitor. This provided an outstanding picture, and I acknowledge that it was with considerable reluctance that I finally left without ever seeing the end of Eraser.

Even so, I can now comment on my overall subjective impressions. My prime observation is that the DVD A300 review player outperforms Brash's DVD A100, which will not be offered to the Australian market.

The DVD A300 player also outperforms my current CD player, and with one possible exception, virtually all the other CD players that I have evaluated in recent years. In fact I am now prepared to acknowledge that with good (or preferably with outstanding) movie software, a DVD player like the DVD A300 offers considerably better value for money than most current, let alone previous generations of Laserdisc players.

The prospective cost, size and flexibility of a quality DVD player places any intending purchaser of a CD player in what I perceive to be an awkward position. When facing that situation, either he or she must now carefully reappraise the ultimate benefit of purchasing a CD player, when a DVD player can provide just so much more.

The Panasonic DVD A300 measures 430 x 295 x 87.5mm (W x D x H), and weighs 3.5kg. The US retail price is quoted as less than the equivalent of \$1000 Australian. Further information on Australian price and availability should be available from Panasonic Australia's Customer Care Centre, on 13 2600. ♦

New personal organiser from US Robotics:

POCKET PILOT READS GRAFFITI

Well known for its modems, US Robotics has aroused world interest with its Pilot — a pocket-sized 'personal information manager' with a touch-sensitive LCD screen which accepts handwritten input via a simplified symbolic alphabet. The device also connects up to Windows PCs or Macintoshes, to upload or download information quickly and conveniently.

by JIM ROWE

With the ever-increasing pace of modern life, more and more people are turning to electronic organisers or 'personal information managers' (PIMs) to help keep up. Most PIMs combine an address book, a 'to do' list, a calendar/personal scheduler, a programmable timer/reminder, an electronic memo pad and perhaps a calculator as well, all in a pocket-sized case for portability.

Most of these devices use a bonzai version of a standard typewriter keyboard, which is OK for many of us in terms of knowing where the keys are — but at the same time a bit awkward, because many of us don't have bonzai-sized fingers. Even feeding in a sentence or two can be pretty frustrating.

Another shortcoming is that most PIMs are fully self-contained, so that the only way to get information into them is by keying it in manually. Similarly the only way to transfer it back out to your computer is by reading the display and transcribing it yourself. As a result 'getting organised' can involve quite a bit of time and effort...

For their new Pilot organiser, US Robotics engineers have come up with novel ways around both of these problems. Instead of a tiny traditional keyboard, the Pilot sports a touch sensitive 99mm-diagonal LCD screen, with a special area at the bottom designed to sense and respond to letters of the alphabet, numerals and punctuation symbols traced in 'Graffiti', an easy to learn graphical 'shorthand' language. In addition Pilot has a serial communications port, to allow fast and convenient transfer of information (either way) between the Pilot and a personal computer — of either the Windows or Macintosh variety.

You trace in the Graffiti symbols with a small pen-shaped plastic stylus, which slips into a matching 'silo' in the side of Pilot's body when not being used. As

The Pilot PIM docked into its matching desktop cradle — which links to your PC via a serial cable. The stylus slips into a 'silo' inside Pilot's body.



many of the symbols in Graffiti are basically just simplified versions of the normal Roman capital letters, they're surprisingly easy to learn — although to help speed things up, Pilot comes with both a 'cheat card' and a stick-on chart for the rear of its case.

Actually, for those who don't even want to learn Graffiti, Pilot provides an alternative — a tiny 'virtual QWERTY keyboard' which can be called up on the main part of the touch-sensitive screen, and 'played' with the same stylus. This is quite practical too.

Pilot is more compact than many PIMs, measuring only 119 x 80 x 17mm and weighing 5.5 ounces. It runs from two AAA-sized alkaline cells, and comes with a matching desktop 'cradle' which connects up to one of your computer's serial ports via the attached serial cable. Also supplied, on floppy disks, is *Pilot Desktop* which runs under Windows 95, Windows 3.1 or Windows for Workgroups, and manages transfer of information to and from the Pilot itself. (There's also a Mac version.) All that's necessary to establish two-way communications is to slip the Pilot into the cradle and press the 'HotSync' button on front.

Included in the *Pilot Desktop* suite are functions which allow direct transfer to and from Pilot's Date Book, Address Book, To Do List and Memo Pad, plus the ability to import and export data to/from a range of common Windows-based applications.

If your job or lifestyle can benefit from a PIM, US Robotics' Pilot has some novel advantages. ♦

Pilot 1000/5000 PIM

Good Points: Compact, uses a stylus and touch-sensitive LCD screen instead of a keyboard. Information can be either written in Graffiti symbols, or tapped into a 'virtual keyboard'. A docking cradle allows easy transfer of information to/from a Windows PC.

Bad Points: Nothing serious.

RRP: Pilot 1000 with 128K memory is \$449; Pilot 5000 with 512K memory is \$549.

Available: Distributed in Australia by the recently opened Australian office of US Robotics, at 473-479 Victoria Street, West Melbourne 3003. Phone (03) 9482 6557, or fax (03) 9329.

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ASTRO: MALAYSIA'S DIGITAL BROADCASTER

Malaysia has written a new chapter in the global book of broadcasting and telecommunications technology, with the inauguration of the first complete end-to-end digital broadcast system in Asia.

by THOMAS E. KING

Malaysia's first communications satellite with high power, Ku-band transponders — MEASAT, short for Malaysia East Asia Satellite) — was placed in orbit in mid January 1996. In late August the remaining hi-tech terrestrial links in the sophisticated communications network, one of the world's most advanced all-digital satellite broadcasting systems, were forged with the opening of the multi million dollar All Asia Broadcast Centre (ABC), south of Kuala Lumpur. This allowed the commencement of MEASAT Broadcast's All Asia Television & Radio Co., known as ASTRO, in late September.

The Malaysian public had been hearing and seeing the names 'ASTRO', 'MEASAT' and 'Binariang' for some time. ASTRO is the brand and operating name of MEASAT Broadcast Network Systems Bhd., while Kuala Lumpur-headquartered telecommunications giant Binariang Sdn Bhd., the owner/operator of MEASAT-1 and future satellites, is a sister company of

MEASAT Broadcast.

Of these names it was ASTRO that attracted the most attention, because when press adverts for the advanced satellite broadcast service appeared last year, they headlined 30+ channels of choice. Four of these new 24-hour TV channels are originated, produced and/or packaged by ASTRO in its suburban broadcast and production complex in the ABC.

The flagship channel is 'RIA', an all-Malay language outlet featuring dramas, movies, music and variety shows, general and business news as well as youth-oriented and educational programmes.

In addition to local productions, RIA offers Malay movie classics in digital quality. Regional and international programming in other languages is either dubbed or subtitled for the majority Malay-speaking audience.

Offering drama serials, talk shows, documentaries, children's programmes, variety specials, programmes for women plus situation comedies, 'Wah Lai Toi' from Hong Kong's TV

(Television Broadcasts Ltd) is the first exclusively Chinese language TV channel in Malaysia.

'Vaanavil' is an Indian language channel. To cater to the language diverse Indian population in Malaysia, ASTRO packages a wide variety of broadcast material, notably blockbuster movies and entertainment specials, produced in several Indian languages.

The Indian language channel, like the Chinese language channel, is subtitled for the general Malay-speaking audience.

The fourth locally originated 24-hour channel is the 'Hallmark Entertainment Network' which offers Emmy Award winning family entertainment, made-for-TV movies, mini series and animated children's programmes.

In addition, ASTRO presents 16 well known regional and international channels: HBO, STAR Movies, the STAR Asian Movie Channel and MGM Gold; three news channels, CNNI, the Hong Kong-based CNBC and ABN; MTV and Channel [V]; ESPN and STAR Sports; the educational channel, Discovery, the Disney Channel, NBC, STAR Plus and the TNT/Cartoon Network. (Some of these channels are localised with the inclusion of ABC-produced programmes and/or language dubbing and subtitling.)

Bringing the number of TV channels to 23 are the two Radio TV Malaysia stations and a preview channel.

Radio buffs haven't been neglected, as the service includes eight thematic digital radio channels as part of ASTRO's broadcast package: Malay and Chinese music channels; Opus, a classic music channel; HITZ, Malaysia's first and only all-hit digital radio station, MIX which plays contemporary hits; easy listening and classic rock outlets and an information radio channel.

YB Dato Mohd Rahmat, Malaysia's Minister of Information, examines the Digital Satellite Receiver (DSR) at the satellite ASTRO launch.





The digital playback and recording area within the Asia Broadcast centre is the most sophisticated on the Asian Continent.

Fast progress

Progress has been fast paced, between the time the licence for Malaysia's first satellite broadcasting service was granted in 1994 and ASTRO signed a contract to become the only satellite broadcaster of the Kuala Lumpur 1998 Commonwealth Games, late last year:

- November 1995: Philips is contracted to manufacture the Digital Satellite Receiver (DSR) in its Brussels factory. Manufacture is expected to be shifted to Malaysia in late 1997. (Parabolic dish antennas are manufactured in Italy but locally assembled.)
- January 1996: MEASAT-1 is launched from French Guyana on January 13. The HS376 Hughes Communications Satellite equipped with 12 x 36MHz C-band transponders and five 54MHz Ku-band transponders is put into an 91.5°E orbital slot, 36,000km above the equator.
- June 1996: The first test transmissions of MEASAT-1 are conducted.
- September 1996: The official announcement of ASTRO and the service's soft launch jointly held on September 25 heralds "the nation's entrance into all-digital, state-of-the-art technology and the dawn of a new era in broadcasting", said YB Dato Mohamed Rahmat, Minister of Information, Malaysia.
- October 1996: The first DSR and 60cm dishes begin arriving in Malaysia. (The parabolic antennas

are mounted to only receive ASTRO transmissions, while the receivers are designed to only decode ASTRO transmissions.)

The price of the Philips DSR, including remote control and the required French-manufactured SMART Card (all ASTRO services are encrypted using the MPEG-2 DVB format) is RM1350 (about \$710) while the 60cm satellite dish is RM150 (\$79). The one-time average installation charge is RM180 (\$94).

The monthly subscription fee is RM80 (\$42). Distribution of equipment and ASTRO subscriptions are undertaken exclusively by Philips retail dealers. An average of 400 installations are made every day, primarily through the 200-strong dealer network which is being progressively expanded to 1000 outlets in 1997.

ASTRO is projecting that 20% of the TV viewship market in Malaysia, or one million subscribers, will be signed up by the turn of the century. If this is achieved it will be recorded as one of the highest takeup rates for a satellite TV service. And all this with a satellite system that was specifically designed for Malaysian conditions.

Malaysia is not only an early user of the MPEG-2 digital transmission standard, it is the first country in a high rainfall region ('P' Zone) to introduce a high powered satellite system for Ku-band direct to home reception.

Transmission power going to the 13-metre uplink satellite dishes can be

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Malaysia's Digital Broadcaster

boosted from a normal 12 Watts to 2.2kW — its full capability — during a thunderstorm to overcome potential rainfade. (This boost provides a 56dBW signal, to ensure a 99.7% service availability rate.)

The ASTRO nerve centre is the ABC, a RM500 million (\$263 million) complex located on a 29-acre site within the Technology Park Malaysia at Bukit Jalil, south of the CBD of Kuala Lumpur. The 350,000ft² facility, one of the largest and most advanced of its kind in the world, is capable of processing up to 500 TV and radio channels and then uplinking them to an expanding number of MEASATs.

The ABC is a 24-hour broadcast and production centre which supports all aspects of the company's operations, including broadcasting and transmission production and an on-line Subscriber Management Call Centre.

The facilities include sophisticated downlink (11 C-band TVRO satellite dishes receive signals from various commercial broadcasters) and uplink (four 13 metre Ku-band satellite dishes send processed signals back to



Distributed by Philips, Malaysia's first satellite-delivered Pay TV service offers 23 TV and eight radio channels.

MEASAT-1) systems.

With ASTRO's satellite television and radio services now fully operational, other ABC departments are involved in the company's next venture: multimedia.

"Because ASTRO's highly advanced home entertainment system incorporates

the power of a personal computer, the system is also an interactive multimedia platform capable of delivering a wide range of services such as home banking, home shopping, stock exchange information and Internet access", said Mr Paul Edwards, Chief Operating Officer, MEASAT Broadcast.

Services to be progressively introduced in 1997 are near Video-on-Demand and Pay-Per-View, as well as a comprehensive electronic programme guide which will provide on-screen programming at the touch of a remote control button.

The Malaysia-wide introduction of a broad range of multimedia services is one major project planned this year; another is the progressive commencement of regional broadcasting services.

Beyond its exclusive charter to be Malaysia's sole satellite broadcast service provider, MEASAT Broadcast is also committed to becoming a significant regional broadcaster — with plans to deliver satellite services to several South, Southeast and East Asian countries. The foundations for this endeavour have been laid, as MEASAT Broadcast has formed alliances with several broadcasters and producers in the region.

The Memorandum of Understanding signed in 1996 with Doordarshan, India's national broadcaster, to establish a joint venture that would provide subscription-based multichannel services to the populous country is likely to be the first to receive attention this year. (The Ku-band MEASAT-1 footprint not only covers all of Malaysia but was configured with a spot beam over India, as well.)

Plans are also under way for introducing direct broadcasting to other regional markets. But the platform for these satellite services will not be MEASAT-1. Instead the satellite used will be MEASAT-2, which was placed in a 148°E slot on November 13.

The payload of Malaysia's second satellite included six 72MHz C-band transponders and nine 50MHz Ku-band transponders. The MEASAT-2 footprint covers the Philippines, Taiwan, Vietnam, Indonesia (Java and Sumatra) and Eastern Australia.

Just over the horizon is MEASAT-3, a Hughes 601 super satellite with hundreds of channel possibilities, presently in its final design stage with a launch tentatively scheduled for next year. To be co-located at 91.5°E with MEASAT-1, it's being designed to be able to provide still more broadcast and multimedia choices to viewers in Malaysia and other countries in South and East Asia. ♦

NSW POLICE SERVICE
INVESTIGATIVE ELECTRONICS DESIGN
(2 POSITIONS)

Two positions exist in the Research & Development Branch of the Special Services Group of the NSW Police Service for designers of Investigative Electronics. These professional jobs involve the concept, design, prototyping, testing, and product manufacture/assembly of equipment for use by Police in investigating crime.

A wide range of technologies and deployment methods are involved, and applicants should be prepared to work in exciting and differing environments such as marine, aviation and intelligence areas. Interaction with like overseas agencies is involved, including personnel exchange, as applicants should be prepared to travel internationally, if necessary for extended periods.

Demonstrated skills and experience in design and construction are required in two or more of the following disciplines:-

- Radio (HF, VHF, UHF and Microwave)
- Video - origination, recording, transmission and reception and encryption
- Audio - origination, transmission and recording, and encryption
- Microprocessors (hardware and software development)

Additionally, applicants should have had experience in one or more of the following fields:-

- Miniaturisation (surface mount technology)
- GPS (Global Positioning System) technology
- Video, Audio and Data encryption
- Modern communications systems (satellite, data and fiberoptics)
- Telephony (fixed and mobile, digital and analog)

These positions represent an exciting and challenging prospect for people with the motivation and energy to be innovative and diligent in this rewarding field of activity.

If you are interested in these positions please contact Mr. Syd Griffith on (02)9950-9344 or by letter to Building 4, 77 Portman Street, Zetland for further information about the job and advice on application requirements when these positions are formally advertised in around six weeks.

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WHAT WILL PC'S BE LIKE IN 2047?

Many visionaries from the world's computing industry came together a few weeks ago at ACM97, the Association of Computing's 50th anniversary conference and exposition in San Jose, California. It was a good opportunity to compare their visions of where computer technology is likely to take us, in the next 50 years...

by MARK HARRIS

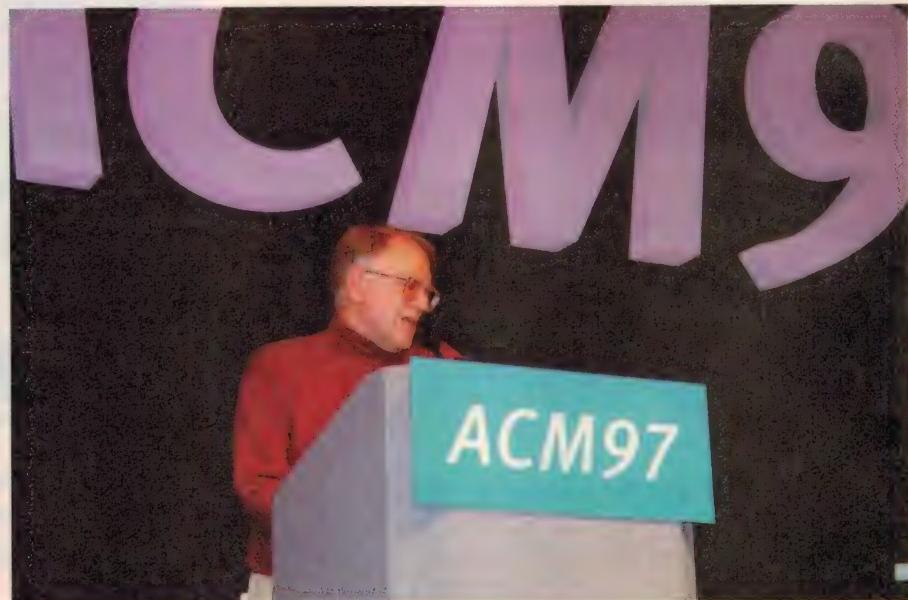
In 2047, with desktop computers using 1-exabit memory chips (one million trillion, or 10^{18} bits) and running under control of a Petahertz microprocessor (1000 trillion, or 10^{15} instructions per second), people will still be doing such early micro computing tasks as balancing their cheques books and wordprocessing — although keyboards and mice will long have been replaced by speech input devices. But they will also be doing a lot of other things, unthinkable even with today's most powerful mainframes and supercomputers.

This was one of many predictions made at the 50th anniversary conference and exposition of the Association of Computing in San Jose, where companies and universities showed off some of the most exotic applications of computer technology being worked on in their laboratories.

Moore's Law holding

Keynote speaker Gordon Bell, the famed Digital Equipment scientist who now consults for Microsoft, said the driving force behind continued technological advancement in decades to come will be the continuation of Moore's Law, which predicts that the number of transistors will double every 18-24 months.

First formulated by Intel founder Dr Gordon Moore about 30 years ago, the rule has held true until now, and Bell said he is confident it will largely continue to do so for the next 50 years — creating memory chips and processors with unimaginable capacities and processing powers. Memory chips, which are moving towards 1-gigabit capacities around 2000, will pass the terabit (1 trillion, or 10^{12} bits) barrier as early as 2007, the petabit level around 2027 and the one-exabit level between 2040 and 2047, depending on whether chip technology improves at just 30% a year, or the 40% average over the past 30 years.



Famous Digital Equipment guru Gordon Bell, now a Microsoft consultant, addresses the ACM during his keynote address.

Similarly, microprocessors that will approach one gigahertz speeds in 2000 will move quickly to the terahertz level around 2020 and one petahertz around 2047.

A lot of that computing power will go into the processing required to create 'natural computing environments', virtual reality computer simulations that eventually will become difficult to distinguish from reality, according to Bell, who also predicted that the computer industry is only a few years away from undergoing a second momentous change in user interface technology, following the conversion from ASCII displays to the graphical user interface of today.

"The user interface will change from WIMP (windows, icons, mouse, pull-down menus) to speech and visual sensors that recognize gestures as minute as eye movement. In the long term, visual and spacial image input from radar, sonar, and global position sensing with a

worldwide exact timebase, coupled with radio data links, will open new possibilities in mobility applications such as robots, robotic vehicles, and autonomous appliances."

Natural computing, life-like simulation and virtual reality are three technologies that are embryonic in development today. The former two are only now starting to take shape in some of the most advanced computer laboratories. They are nuggets of technology that will someday become mainstream, said Bob Metcalfe, the founder of 3Com and publishing magnate with his IDG publishing conglomerate. Before 3Com, Metcalfe was part of the team that developed packet switching; later, at Xerox's Palo Alto Research Center, he co-invented the Ethernet networking technology.

Metcalfe said he believes the technology that will dominate the markets of 2025 is already here today. "It already exists — just like there is nothing going

on today, with the possible exception of the Web, that wasn't going on 25 years ago. In a small way, a screwy little way, or in a lab, whatever it is that is around in 25 years is probably around if you were just aware of it."

All inclusive Internet

An undeniably large part of the computer revolution over the next five decades will be the Internet, Bell predicted, as the worldwide computer network will expand beyond anything even remotely conceived today. For one thing, a number of existing and new types of computer networks will all be integrated into a massive Internet system that will overtake our professional and personal lives.

"Everything that is cyberspacable will be available in cyberspace — including conferences such as this which will take place entirely on the Internet", Bell predicted, adding that besides the expansion of existing networks, we will see new types of network that will integrate into the Internet.

Home-based networks will emerge to connect and control just about anything running on electricity. Such networks will fill the bathtub and turn up the heat after the alarm clock tells the bathroom it's about to wake up the family. The kitchen will also spring into action preparing coffee, toast and other breakfast items while you may be exercising and listening to your e-mail. And if the bathroom scale shows you've eaten a too much the previous day, the network could simply lock up your refrigerator or suggest a diet that will get you back to your optimum weight.

Even more intriguing will be 'body networks' that will not only integrate mobile computing and communications devices with home and office computer systems, but even include advanced medical sensors that protect people by alerting them to a possible heart attack, stroke, or other life-threatening events. They will sense if you've caught the flu, and order antibiotics and other over-the-counter medicine from the drugstore.

Other new computer and communications networks will be found in cars, airplanes, and hotels.

Today, only 20 to 30 million people and business are connected to the Internet. In the next couple of years that will expand to several hundred million.

But in 10 years, Bell predicted, there will be more Internet addresses than there will be people on the planet. That is because increasingly, humans will not be the only things linked to the Internet. Homes, cars, planes, ambulances, police

cars, and even some home appliances will have their own Internet address.

Military not in control

The pace of commercial technological advancement has become so frantic, said former US Defense Secretary William Perry, that the US military no longer has any control over setting the course for mainstream technology advances.

"Commercial markets drive technology directions and developments. During the Cold War, the military provided the leadership for much of the technology that was being developed. Today it is the other way around", Perry said.

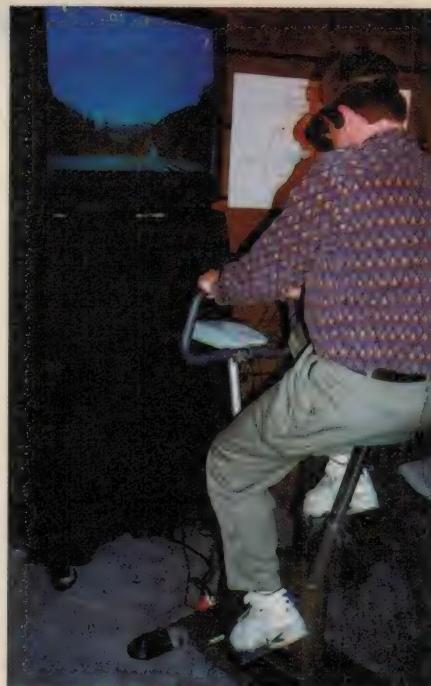
Already the Pentagon has adapted to the change by relying far more on off-the-shelf technology than custom-designed systems. During the 1980s and 90s, these systems, when they were finally delivered, were already obsolete compared with commercial technology.

AI on the way

Artificial intelligence will enter into our lives in many different ways during the coming decades. As computer speeds and memories approach that of the human brain in the next 50 years, computer will be able to match human intelligence, if not exceed it in many areas. But don't let that depress you, Bell said.

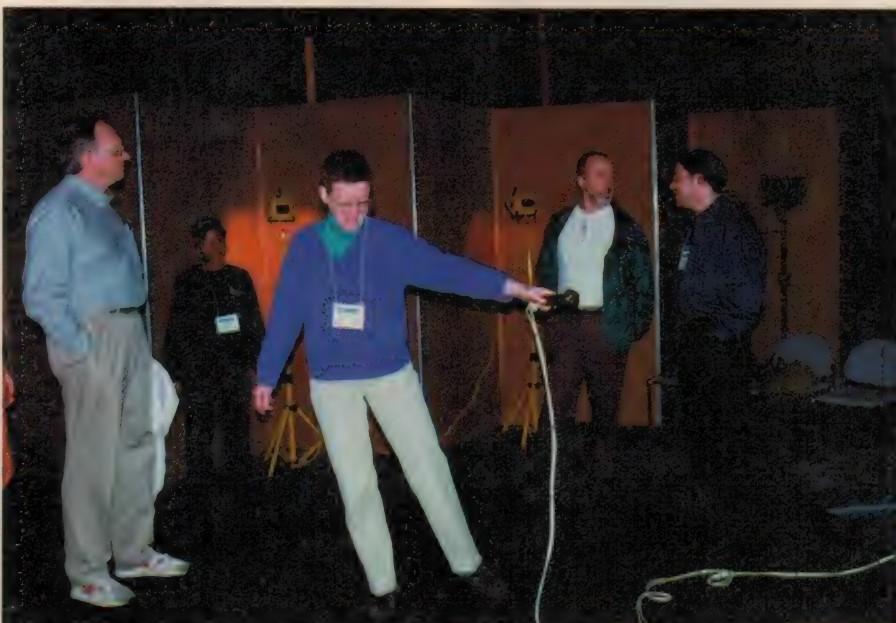
"Knowing that Gary Kasparov is likely to be the last human world chess champion is just like knowing that a cheetah can do 60 miles per hour. It doesn't need to depress you."

One way people will be able to expe-



Matsushita's virtual reality exercise bike, with a simulated country road environment visible on display (duplicating that seen by the subject on the VR headset).

rience the highest level of AI will be later this year when Deep Blue, the world's first computer to defeat a human world chess champion in a single game of chess, will take up residence on the Internet — where chess players from around the world will be able to test their skills against the grandmaster-level machine.



Vibespace II lets you create music by moving a sensor through a 3-D space 'containing' sounds from a variety of instruments.

What will PC's be like in 2047?

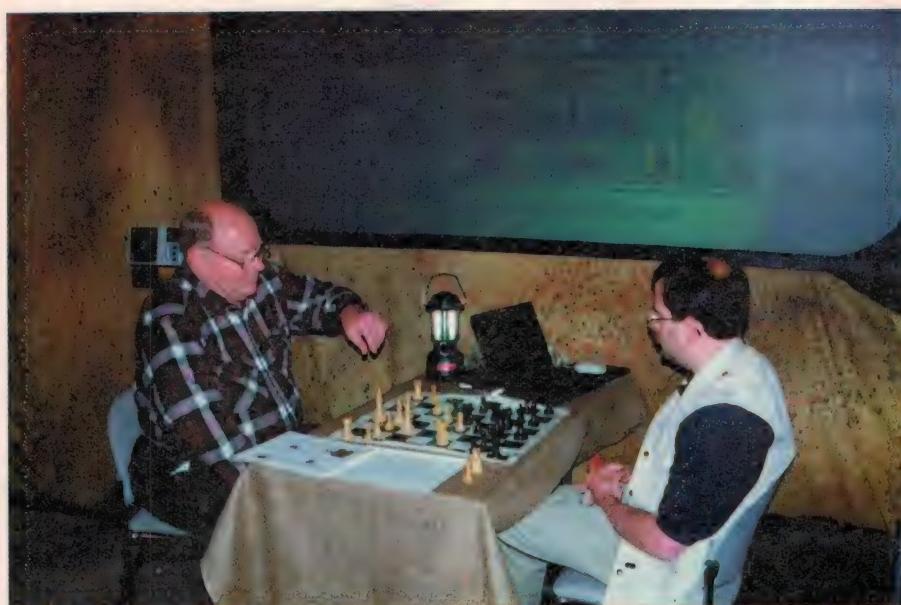
The technology developed for Deep Blue, which is preparing for a May rematch with Kasparov, will also soon be spun off into medical and business applications. Deep Blue's ability to 'think' nine or more moves ahead and to incorporate advanced levels of strategy into its decision-making process, for example, will enable Wall Street investors to make buy/sell decisions based on huge volumes of data and 'what-if' scenarios involving constant changes in the large number of variables (interest rates, currency exchange rates, commodities, political decisions, etc.) which can influence developments on stock exchange markets.

In another Deep Blue spinoff, IBM will also make a 'Light Blue' version of the program available for PC users, to test their chess skill against a grandmaster-level computer.

VR to enter mainstream

One of the technologies that is around today on a primitive level but which is likely to become mainstream over the next 20 to 30 years is virtual reality. Nearly one in every two or three exhibits at the ACM show involved some aspect of virtual reality, from the traditional drive-through and fly-through scenarios to a virtual office (designed by IBM) in which the user clicks on computer-rendered representations of familiar office objects such as telephones, fax, file cabinets, etc.

The interface appeared somewhat similar to the ill-fated BOB user interface Microsoft tried to impose two years



Deep Blue team members demonstrate 'Light Blue', a CD version of the program that may be launched by IBM in the next couple of months as Deep Blue Jr.

ago. The IBM 'social interface', however, sported a more mature business look.

An early adapter of commercially viable VR, it seems, will be the exercise equipment industry. For many, using exercise equipment such as bicycles and treadmills is a rather boring experience. But not with Matsushita's VR interface, which links the exerciser with a computer program running a highly realistic simulated environment, such as a country road winding its way through forests, towns and hills. The system adjusts both to variations in the user's exercise speed, as

well as to the terrain. If the terrain changes to up-hill, the exerciser automatically increases the friction, or conversely, eases it when going down a hill or bridge.

Another major advance in VR technology was demonstrated by Fakespace, which enables you to work in a simulated environment. Wearing 3-D glasses and special VR gloves, users face an 8 x 8 foot projection screen on which they can execute commands simply by reaching out and 'pushing' virtual command buttons that appear suspended in air in front of the user. They can also pick up and move projected objects within the 3-D workspace using imaginary pointers. Fakespace sees applications such as in military command and control, as well as in surgical training and automotive design markets.

Wait — there's more

Other innovations demonstrated at the ACM expo included:

- Microsoft demonstrated new speech synthesis technology that enables a PC to simulate any kind of speech input, virtually duplicating the user's speech. Microsoft said the technology has application in areas such as reading e-mail, to allow a traveling executive to have the e-mail read back in the familiar voice of his secretary.
- Making music out of thin air. Vibescape II, created by the

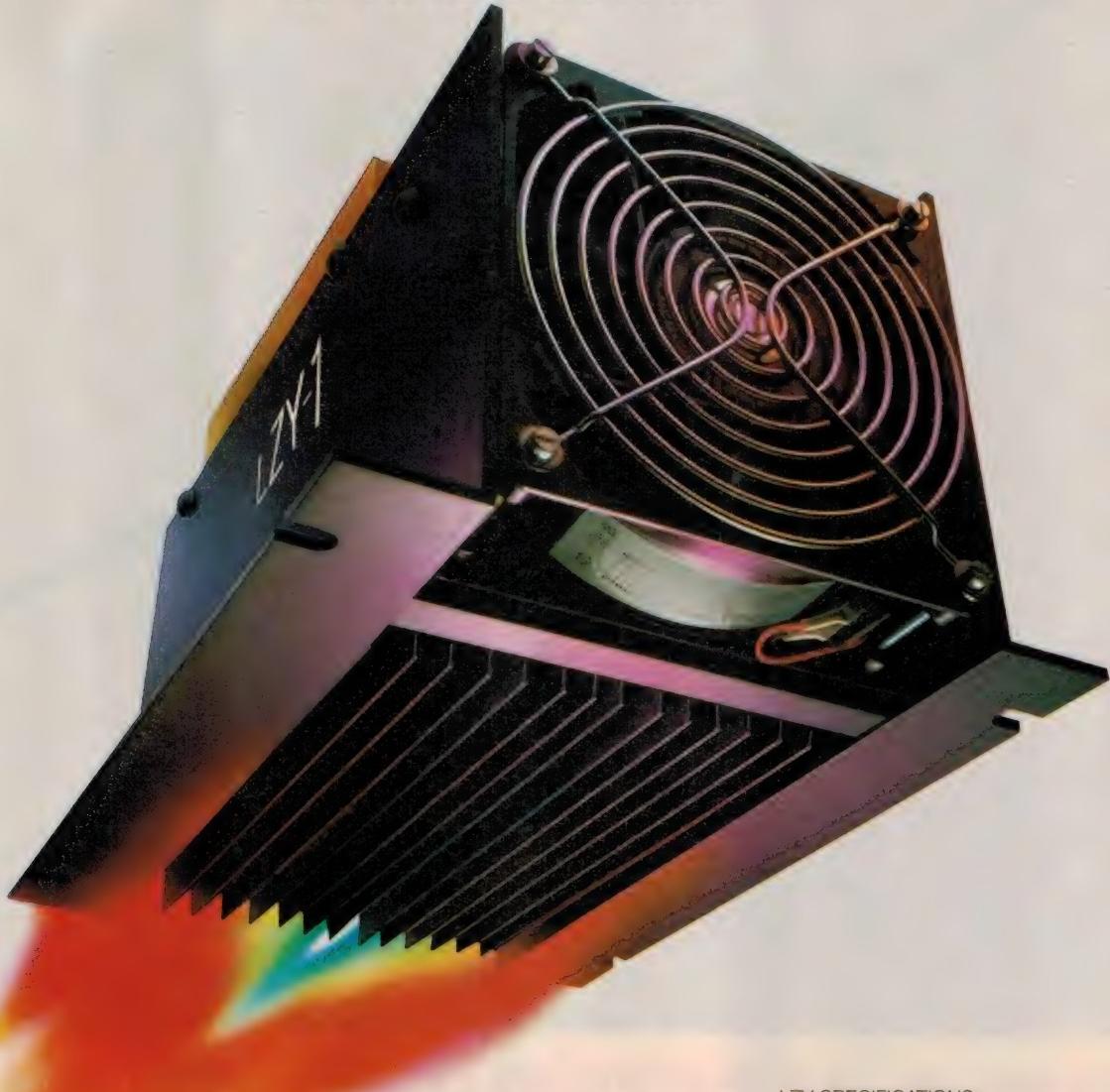


Cinematrix shows its group input or 'mouse for the masses' technology, which allows members of an audience or group to 'vote' using glowing wands.

(Continued on page 42)

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RADIO-ELECTRONIC COMBAT AND ELECTRONIC WARFARE - 2

Having covered some of the basic concepts of electronic warfare in the first of these articles, the author now looks at some further techniques used in what can be a fascinating battle of wits and technology between adversaries. Some of the applications of electronic warfare to the conduct of the Gulf War are also discussed.

by JOHN BELL B.E., M.Eng., F.I.E. Aust, F.I.E.E.

Last month we noted that radio and electronics have become an integral part of modern weapons systems and their control, and discussed some simple concepts of so-called electronic warfare (EW). We saw that an essential feature of the modern battlefield was to retain and maximise the integrity of the required

Command, Control, Communications, Computers and Intelligence (C⁴I) required by senior commanders. It also follows that selected information and resources must be made available to personnel involved at the battle front.

Almost without saying, the denial of adequate C⁴I to one's opponents

places them at a significant disadvantage. Radio electronic combat, which includes the widespread use of EW and information technology (IT), is aimed at achieving these objects. It is also reasonable to assume, as in the Gulf War, that the successful application of the total package of radio-elec-

Fig.8 (opposite): An RAAF H-Model Hercules from 36 Squadron, Richmond shown deploying flares off-board. (Courtesy Australian Department of Defence)

tronic combat may be used to reduce casualties and material destruction. We will now look at some other methods of confusing the defences.

Cover jamming

Cover jamming is a technique where signals are carefully introduced into an opponent's radar so as to effectively jam the radar without the knowledge of the defence. Today, signals with appropriate modulation can be beamed at a specific radar in such a manner that the real target may be obscured from view.

Probably the best-known application of this technique was used to effect the escape of the *Scharnhorst*, *Gneisenau* and *Prince Eugen* under the noses of the British from Brest to their home ports, in February 1942. Each day German operators created a small but daily increasing amount of noise at dawn, which the British operators noticed. Believing something might be amiss they summoned Robert Watson-Watt, the father of British radar, who advised them that it was probably due to noise generated by the rising sun.

The operators were thus lulled into a sense of false security and took no notice one fateful day when, at the expected time, noise rendered their HF radar system ineffective. During this short period of grace the three battleships made their dash and were out of range of the British guns before it was realised what had happened.

Today, techniques are much more refined but the general principle remains the same.

Off-board decoys

Aircraft are particularly vulnerable to attack by heat-seeking missiles, which home into the heat generated by their



A Blackhawk helicopter deploying flares. Such flares are designed to deceive the infra-red homing system of a heat-seeking missile, into 'thinking' the flares are its target rather than the heat-generating sections of the aircraft. (Courtesy Australian Department of Defence)

engines. This form of attack is particularly deadly, as the infrared sensors in the missile head are passive and simply follow the heat source — hence a target may have no warning that a missile is approaching.

Most military and other special aircraft are fitted with some sort of warning device which allows some sort of countermeasure to be effected. A common counter-measure is to drop flares which mimic the heat from the engines; if correctly deployed these should present the infrared homing mechanism of the missile with a more attractive target. These are known as off-board expendable decoys.

Next time you see a real-life low flying attack in the television news, watch carefully to see if you can spot flares, as well as chaff, being dispensed off-board.

The threat from infrared homing missiles is serious in any conflict. They are effectively shoulder launched 'fire-and-forget' devices, with no exotic ground support being needed. Both in Vietnam and during the Gulf War it was these

missiles which caused most casualties amongst the American and UN aircraft.

Navy ship defences now need to be able to counter the added threats of the radar-guided and heat-seeking missiles to gunfire, bombs, torpedoes and mines. During the Falklands war, the air-launched Exocet radar-guided missile did horrific damage to the British fleet. Traditionally, ships have fired chaff from deck-mounted launchers or used on-board jammers to defeat such radar-guided weapons.

To supplement these EW operations, Australian Defence Personnel and Industry have developed an expendable off-board decoy called Nulka, which is aboriginal for 'be quick'. This is a rocket powered vehicle which is launched away from the ship (see Fig.6), designed to attract an incoming missile away from its target (see Fig.7).

There are a variety of off-board decoys, towed behind a ship or air-launched in some fashion. Fig.8 illustrates a RAAF Hercules ejecting flares in a practice scenario which would entice an incoming heat-seeking missile away from the aircraft engines.

Self protection

To assist in self-protection of expensive and vulnerable platforms such as ships, aircraft and tanks, modern military designers now give a deal of thought to reducing their attractive radar or heat signatures — adopting an electronic form of camouflage. The US Stealth bomber is a superb example, with great attention having been given to the shape of the aircraft, the positioning of the engines and other matters. Similarly ship designers can reduce radar

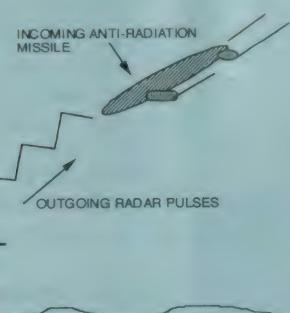


Fig.10: An anti-radiation missile (ARM) will home-in to, and destroy, an active radar by following its signals to their source. Ground defence radars must therefore be careful not to attract ARMs, whilst endeavouring to track other targets.

echo and 'hot spots' by careful design: today, some ships in a hostile situation routinely cool their hot-spots using water.

Communications

Communications are essential to the orderly control of military forces. For this reason very sophisticated systems have been designed to ensure, as far as is possible, that communication links are secure. Messages may be enciphered and spread-spectrum techniques are used.

The use of a predetermined sequence of frequencies to transmit a message makes it very difficult for an enemy to intercept or employ jamming effectively. It is far easier to jam a transmission whose frequency is known, as less power is needed. Conversely it is impractical to jam the whole spectrum, for one would interfere with friend or foe alike.

Short messages are the flavour of the day as an alert enemy, given enough time, may be able to locate the transmitter concerned.

In local tactical situations, communication signals are generally in the HF band. However, the HF system may well be part of an integrated communication network where VHF, UHF and microwave links are also involved. Fig.9 indicates how a simplistic commu-

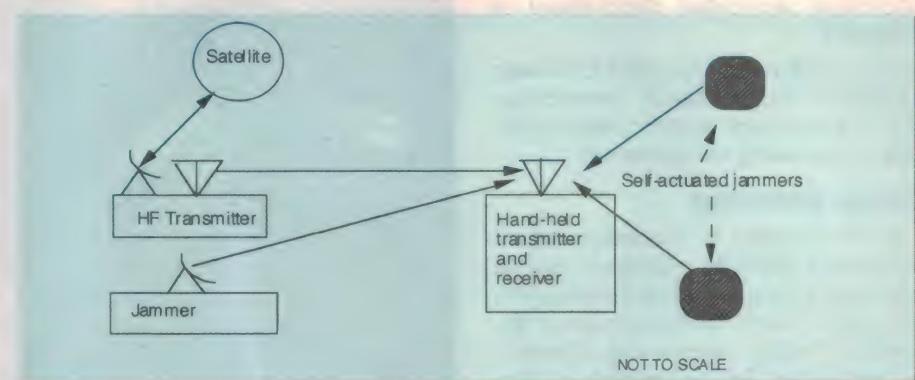


Fig.9: A simple HF jamming system. The jammer must always target the receiver, making it difficult or impossible to decipher messages. Self-actuated battery powered jammers, dispersed behind enemy lines, may also contribute to disrupting communications.

nications link could be jammed: in practice such links are operated and have in-built protection to avoid such problems as much as possible.

Destruction

Life is not meant to be easy for the practitioners of EW. Simple jamming and the generation of radar signals have an unwelcome effect, because these give a clear indication where a potential target is located. Anti-radiation missiles (ARM's) which will seek out and home in on the jamming or radar system are now an integral part of advanced

armouries. Some missiles are believed to have the ability to switch from radar guidance to a 'Home on Jam'.

The impending destruction of a Ground Defence Radar is shown in Fig.10, due to an approaching anti-radiation missile, homing in onto the radar's transmitted pulses. This is part of total radio-electronic combat, where an enemy's ground-based radar defence may be effectively silenced by the threat of ARM's. This is a tactic commonly used in the application of EW in radio-electronic combat.

Tactics

Tactics in the deployment and use of the electromagnetic spectrum are complex, and closely guarded secrets. Hence, whether in peace or war, the use of the electromagnetic spectrum by the military is under carefully controlled conditions. Wartime frequencies may be different from those used in peace.

Electronic combat tends to be a very clandestine business. A major activity is known as 'electronic support measures' (ESM), which is fundamentally a data gathering exercise. Listening posts will try to establish as much about an adversary's use of the electromagnetic spectrum as possible.

Even before the Second World War, the Germans sent their R101 airship down the English Channel in the hope that the newly installed British Chain Home Radar System would be switched on; the British did not oblige. And, of course, in the background are the cypher and code breakers armed with their computers.

It was President Woodrow Wilson

Fig.6: An Australian Nulka off-board decoy being launched from a Navy vessel. (Courtesy Australian Department of Defence)

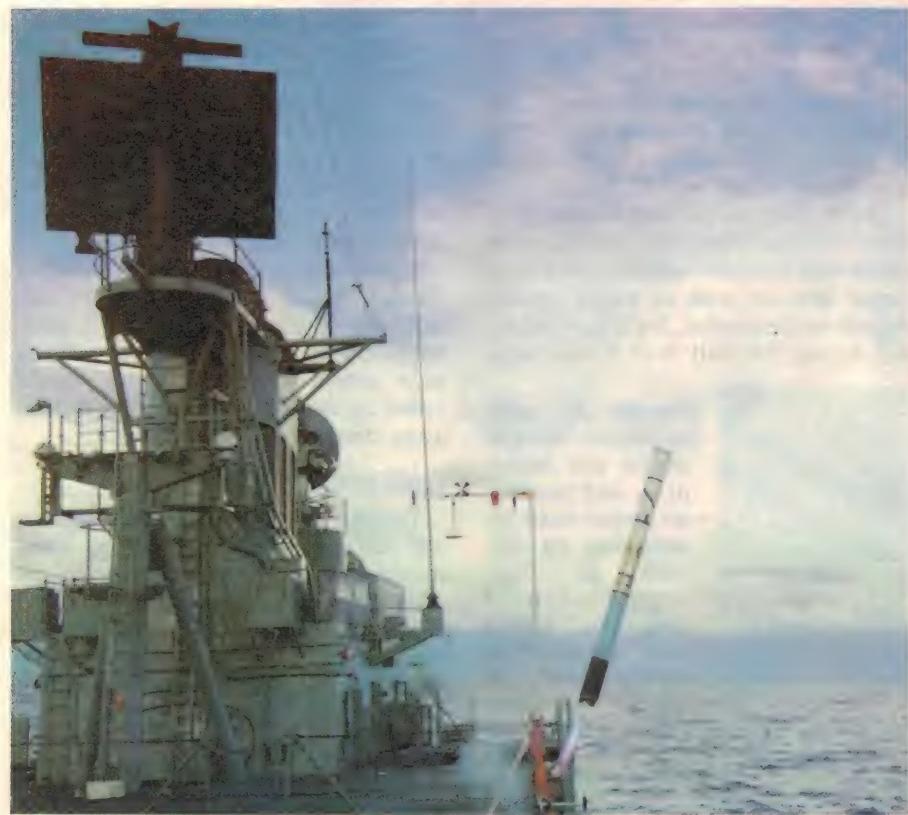




Fig.7: An artist's view of an Australian Nulka decoy diverting an incoming sea-skimming missile away from its intended target. (Courtesy Australian Department of Defence)

who said that "Gentlemen do not read each other's mail". Unfortunately, in war, this sentiment is overlooked. Intelligence is just too important.

Modern EW is born

Today the military authorities speak of C⁴I — Command, Control, Communications, Computers and Intelligence. A more appropriate term used is radio-electronic combat, of which EW is an integral part. An Experimental Command Centre con-

cept, developed within Australia, was shown in the first of these articles.

It was the brilliant and concerted applications of C⁴I by the United Nations Desert Shield Task Force which overcame the forces under the control of Saddam Hussein, in Operation Desert Storm. The application of electronic warfare to the Iraqi C⁴I system reduced it to almost zero effectiveness, leaving the fourth largest tank force in the world and a huge army with almost no idea of their role. With almost no intelligence or effec-

tive communications, their commanders were easily duped and as a viable force they were effectively rendered impotent, and left as easy targets for UN forces.

It was a radically new form of warfare which was unleashed in the Persian Gulf. Not only did it encompass the concepts of EW already explained, but now it was to exploit knowledge. Information was obtained in many ways — some obvious, some less so.

Overflying satellites and specially equipped aircraft have long been able to produce respectable photographs of selected terrain. Now, of course, as those of you familiar with the recent impact of the Internet and World Wide Web will realise, such pictures in digital form could be rapidly transmitted to intelligence gathering and analysis centres. And such information could then be retransmitted to local ground commanders: no longer was it necessary for UN forces to deploy so many reconnaissance missions.

Today, in retrospect, the reader will readily grasp what a tremendous advantage the US and its allies had over the forces of Saddam Hussein. As Alan Campen (see Bibliography) said "It was a war where a few ounces of silicon in a computer was probably more effective than a ton of depleted uranium."

Those who watched the unfolding of the conflict on television saw the use and results of advanced weapons systems, operated by professional armies. The general viewer would have been unaware of all the background aspects of radio-electronic combat, which made victory by an outnumbered and hastily assembled NATO force possible.

Summary

So far we have covered some historical and basic technical features of EW and seen how the technical picture has been changed dramatically following the invention of the integrated circuit (IC), which has led to remarkable advances in processing power. Some of the best technical brains grapple with the enormous challenges posed in this state-of-the-art electronics and communications, also involving mathematics, physics, signal processing, computers and accompanying software.

EW, C⁴I and radio-electronic combat are effective force multipliers, as they can reduce the number of armed personnel engaged in a conflict. Certainly, as in the Persian Gulf, it should be clear that the application of radio-electronic

(Continued on page 87)

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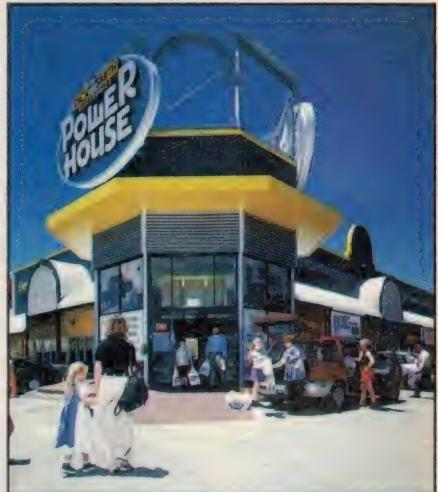
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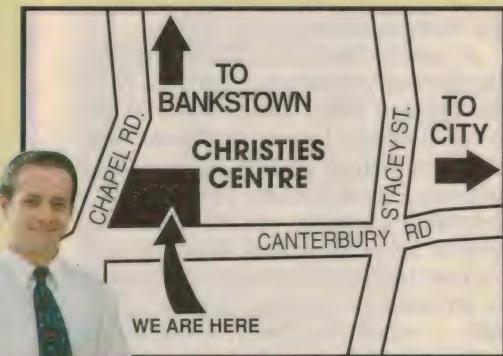


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Enigma, Ultra, Bletchley Park and the Colossus:

THE 'GREAT SECRET' OF THE SECOND WORLD WAR - 2

In this second article dealing with the codebreakers of Bletchley Park and how they cracked Germany's codes during WW2, based on the Enigma machine, the author discusses the development of mechanised encyphering and decyphering machines, and the work leading to Colossus — arguably the World's first programmable electronic computer. He concludes by explaining how the Bletchley Park complex has now been turned into a fascinating museum of codebreaking and computer technology.

by PETER R. JENSEN, VK2AQJ

Until the advent of machine encyphering and (later) computers, the use of complex, clever and secure cyphers usually involved a considerable amount of effort by cyphering clerks, and mistakes were common if not inevitable. Also, despite the need for conscientious work to avoid penetration of the cyphers, clerks always seem to be badly paid. For these reasons, quite early there were attempts to mechanize the chore of converting plaintext to cypher and vice-versa.

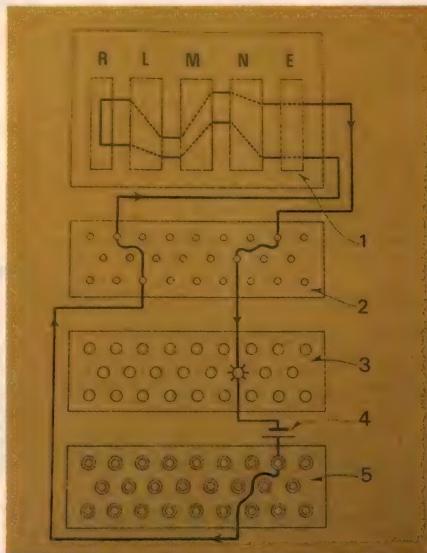
In the period immediately following the First World War there were several attempts to produce more sophisticated and secure cyphering machines. In the United States the work of Hebern led ultimately to cyphering machines made in Sweden by the Hagelin Company, and these were later adopted by the American army. By comparison the work of Scherbius in Germany led to the adoption of the Enigma encyphering machine by the Wehrmacht during the 1930's.

As can be seen from the illustrations, the Enigma cyphering machine used by the German army looked like a strange cross between an old fashioned typewriter, a manual adding machine and a telephone switchboard. However as a relatively complex electro-mechanical device, its purpose was simply to convert the letters of a message typed into it to an insanely complex 'jumble' of letters — which, in theory, could not be understood by any third party without access to a similar machine.

In addition to having access to another Enigma machine, the recipient of a coded message had to set it up in particular manner, which was set out in instructions distributed around to the operators in a very organized, efficient and secure manner. Despite the adminis-

trative and logistic problems of providing instructions to the operators in the field, in war conditions, this was relatively small as compared with what would have been required if a 'one-time pad' system had been employed.

In detail the Enigma consisted of a keyboard, much as one finds on an electric typewriter, connected to a panel of lights which were battery operated, with the intermediate wiring carried through a system of rotary switches and a plug-board. Each of the switches — or *rotors*, as they were called — had engraved upon them a random alphabet and in the case of the Enigmas used by the German army, there were three sets of rotors per machine in use at any given time. Later



The basic circuit for an Enigma cipher machine, showing how the keyboard and lamps were linked via both the patchboard and the cipher wheel rotors.

two further rotors were supplied, so that three out of five rotors could be used at any given time.

The schematic diagram shows how the current from the battery flowed through a key when it was pressed, wound its way through the jumble of the wiring in each of the three rotors, was reflected back through an end rotor and finally emerged to light up a bulb in the display board, having passed through the final complication of a plug and patch board.

If the first letter of the message was 'A', for example, somewhere on the array of lights another letter would light up: For example 'Z'. If one returned the machine to its basic setup position and then pressed the letter 'Z', the bulb representing the letter 'A' would then light up. A message encoded by one machine could be decoded by another machine at the receiving end by simply typing in the code and copying down the letters which lit up at each key press, assuming that it had been set up the same way as the sending machine.

This important property of 'reciprocity' made for a very flexible and rapid method of coding and decoding messages. However, inclusion of the reflector rotor in the Enigma machine produced one subtle but serious cryptographic fault. This was that no letter could ever be encoded as itself. This feature was not emulated in other cyphering machines developed for the Allies or subsequently.

The secret listeners

From the very earliest days of wireless, it was quite obvious that as a system of communication, it was inherently vulnerable to eavesdropping. One of the reasons that the British Army was

initially so reluctant to become involved with the new method of communication was the realization that there could be a problem in preventing the enemy from hearing what was being said as messages were passed.

As Sir Oliver Lodge was to comment in 1903, "Wireless or open methods cannot compete in point of secrecy or certainty with closed or cable methods, and can only compete with them in point of speed and accuracy by aid of great improvements and new inventions involving little less than discoveries".

While the British Navy was to become the Marconi Company's first major client, despite the reservations of the Army, the problem of security remained and this was to become painfully apparent during the early part of the First World War. Wireless direction-finding coupled with decyphering of the German signals was a significant element in at least two partially successful Naval engagements, at the Dogger Bank and later at the battle of Jutland. In the latter engagement, it was only the occurrence of administrative bungling that prevented Britain from administering a major blow to the German Imperial Fleet and thus shortening the war by a number of years.

Many of the very painful lessons of the First World War were to serve as models of what to avoid in the Second World War. In particular the Germans, dismayed by the vulnerability of their signals (revealed rather incautiously in the 1930's by British authors who had been participants in the process of decyphering during the war) were to turn to machine-generated cyphers. By comparison the British were to consolidate, centralize and coordinate radio signal interception and decyphering, under the control of the Government Codes and Cypher School.

By comparison with the Germans, the British mobilized its legion of radio amateurs, not only into the armed services but also into a clandestine corps of 'listeners', known as the 'Y' Service, who provided much of the raw material for decoding at Bletchley.

Soon after Hitler came to power in 1933, the new Nazi administration, fearing that free spirited radio amateurs were likely to represent a security risk, shut down all the radio clubs and, more seriously, made very little use of the talents of the technically expert amateurs. They came to regret this, as Field Marshal Goering was to acknowledge at a later stage.

Quite apart from the Polish and British success in breaking the cyphers



An original German Enigma cipher machine. The inset picture shows a set of its cypher wheels or 'rotors' — each one essentially a multipole rotary switch with pre-wired encoding.

used by the Germans, the immensely important part played by those who intercepted the radio signals which carried the enciphered information has now become clear. In this regard a recent book by West, entitled *GCHQ*, has helped to dispel much of the deliberately obscuring camouflage surrounding the monitoring of the radio frequency spectrum.

The covert listeners who undertook this task were, during the war years, gathered together in a variety of listening establishments. The headquarters of this operation was originally known as the Government Codes and Cyphers School. Later this name was changed to

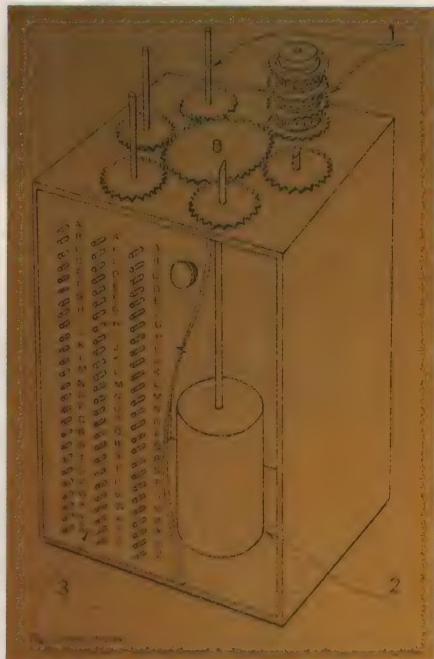
the Government Communication Headquarters (GCHQ).

The 'Bombe'

Although the Turing conclusions regarding the 'Capacity of one machine to analyse the complex output of another' was first applied to cypher problems in Poland in the 1920s, it was brought to its most significant application in Britain after the commencement of the Second World War.

During the 1920s, with an escalating level of German belligerence and an increasing feeling of isolation, the Poles took an ever greater interest in the cyphered signals of their dangerous

Germany's Hans Guderian, inventor of the Blitzkreig strategy, shown directing an attack from his commanding vehicle. He is giving orders to a clerk using an Enigma machine (bottom front).



The arrangement used in the original Polish 'Bomba' machines, which were the first to decypher the Enigma codes.

neighbour. Quite early on the Poles were able to intercept an Enigma enciphering machine and make a copy of it without being detected. However, having the machine was only a small part of the problem of dealing with the Enigma code and other devices were needed to assist in the process of cryptanalysis. One of the most important of these pieces of apparatus was a large electro-mechanical device known as a 'Bomba', which was used to assist in testing alternative settings of the Enigma cyphering machine.

For a while, during the 1930s, the Poles were able to decypher a good deal of the German traffic. However this came to an end quite suddenly when the two extra rotors were introduced in 1938, increasing the alternatives from three to five. Where previously the Poles had been able to carry out the decryption task with six of the Bombas, now 60 would be needed.

At this stage, realizing that the Germans were very close to commencing an invasion, the Poles provided all of their work to the French and the British at a meeting in Warsaw. Ultimately their foresight and generosity in providing this valuable material to the Allies was to pay dividends in winning the war. However in the short run it

did nothing to delay or defeat the new German military tactics of Blitzkreig, employed to devastating effect during the next few months.

In the accompanying illustration, air power, as applied via Stukka dive

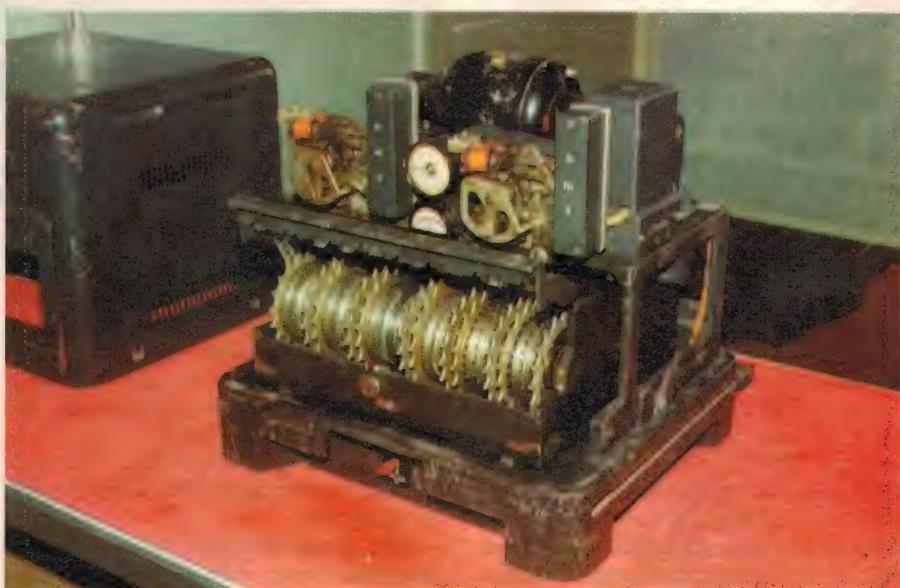
bombers, is seen mirrored by the rapidly deployed armada of tanks on the ground. Here also is seen the inventor and leader of the Blitzkreig, Hans Guderian, in his command vehicle. He is overseeing the transmission of a message via a clerical soldier and the Enigma enciphering machine in the foreground. Radio as the means of keeping control of the rapidly moving and advancing Tank squadrons was of course the critical element in the German success during the Polish campaign.

With the engulfing of Poland, much of the constructive work of cypher breaking passed to England, and specifically to the new secret centre at Bletchley Park. Here the required number of what from now on would be called 'Bombe', constructed by the British Tabulating Machine Company of Letchworth, were set up and the job of breaking the Enigma-generated code began in earnest.

Encyphered teletype

At a later stage of the War and quite separate from the system which generated the Enigma codes, there was another, supposedly even more impregnable system developed in Germany. This method was used to transmit high level traffic via both radio and telephone lines, and was based on two Teletype encrypting machines.

The first of these was in effect a sup-



Later in the war Germany developed two enciphering systems for teleprinter machines, regarded as even more secure than Enigma. The Lorentz SZ 40 (above) worked with standard teletype machines, while the Siemens T 52 'Geheimschreiber' (secret writer) integrated the two functions. (opposite page)

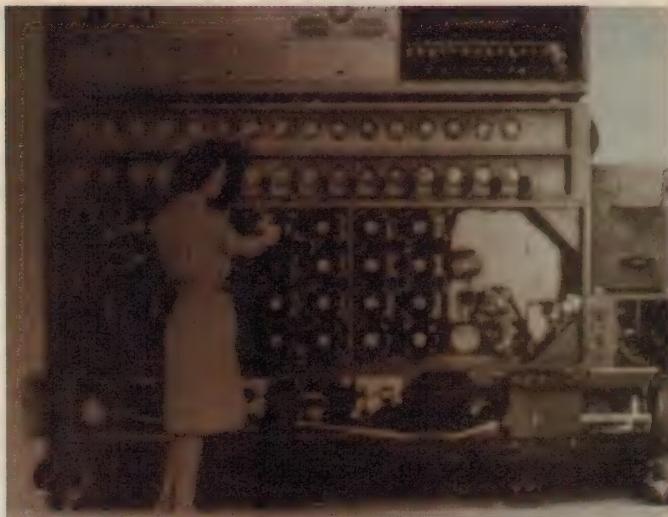
plementary device to be attached to a conventional teletype machine, and was made by the firm of Lorentz. It was known as the Schlüsselzusatz 40 or 'SZ 40', had two sets of five encoding wheels and can be seen in the accompanying illustration. Subsequently a second version was produced known as the SZ 42.

Later again a composite teletype and encyphering machine was produced by the firm of Siemens and this was known by the Germans as the T 52 or more commonly the 'Geheimschreiber' (secret writer). Both of these machines employed multiple rotating drums with adjustable projecting pins which were used to encode the plaintext typed into the teletype. The machines in turn produced encoded Baudot using the method devised by Vernan.

Baudot, which was the normal output from a teletype machine at that time, is frequently referred to as a 'code' because it uses a system of marks and spaces (tone or no tone) to represent the letters of the alphabet and the numbers. For computer literate people, this will be recognized as a binary form of code as used by computers in the machine language with which they are given instructions. In general principle, Baudot is very similar to ASCII code and also is not dissimilar to Morse code.

In terms of hiding the meaning of a message, Baudot by itself is no more difficult to read than ASCII or Morse code. All one needs is a teletype machine of identical construction and the messages can be read.

A later British 'Bombe' machine being used to decypher the more elaborate five-rotor Enigma codes, which the Germans introduced in 1938.



To encypher the Baudot code of one machine so that it could not be simply translated by another machine, a set of rotors with projecting pins was used to add binary cypher elements to the binary code that resulted from the plaintext as it was typed into the Teletype machine. These pins were located on the rims of the rotors and as they turned the plain binary Baudot code was encrypted by the addition of binary elements supplied by the pins. This process involved the creation of a long repeat cypher key, determined by the number of rotors and pins.

The first computer

Needless to say, the complexity of the output from the teletype encyphering machines required an equivalent level of complexity in analysis for messages

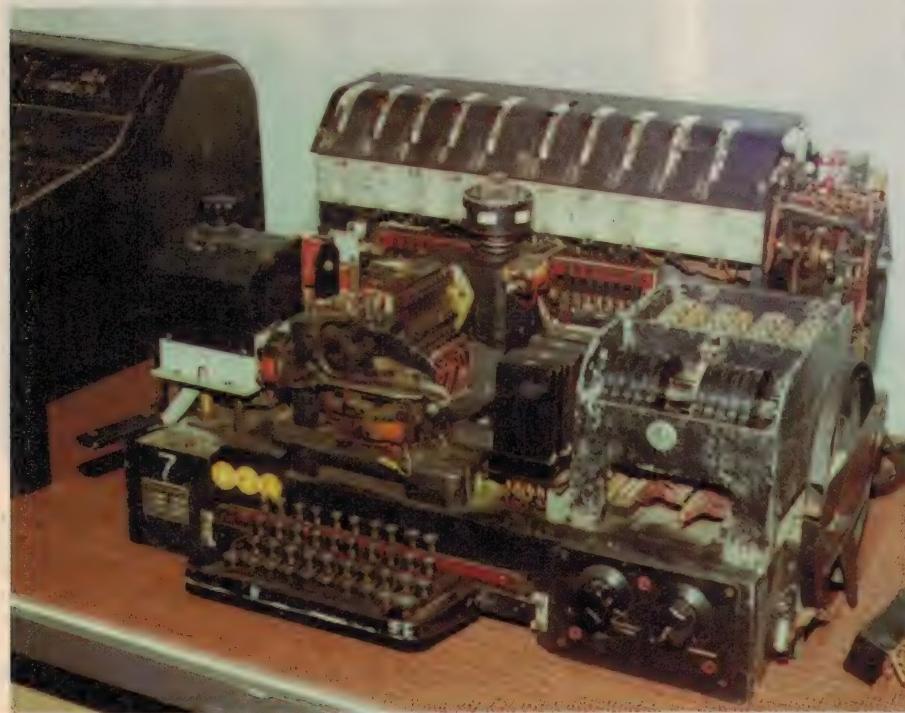
to be extracted from the 'jumble' of encyphered bits. As the result of some very significant inventive thinking by Alan Turing, Max Newman and others at Bletchley Park, a specification for a machine was developed which was intended to deal with the problems set by on-line encoding of teletype.

The first product of this inspired work was the creation of an electro-mechanical device which was constructed by technical staff of the Post Office, and soon came to be known as 'Heath Robinson'. This was because of its resemblance to one of the strange machines drawn by the artist Heath Robinson, who produced illustrations for the daily newspapers in wartime England.

The principal designer of this first machine was C.E. Wynn-Williams of the Telecommunications Research Establishment, and to a large extent it relied on conventional telephone and telegraph technology of the period. In particular, and an important portent for future developments, it incorporated about two dozen gas-filled thyratron valve switches, which were able to emulate the switching function of the mechanical rotors (rotary switches) of the Lorenz and Siemens machines.

The 'Heath Robinson' machine was to prove very effective, despite being rather prone to mechanical troubles. It made use of punched paper tape to provide the data input, which was moved at high speed. Those that operated these machines recall that sometimes during a run, the paper tape would break and the air would be filled with small pieces of paper, rather like confetti.

With the advantages of a machine basis of analysis established, it was seen as appropriate to extend the technique and further development led to a new and far more powerful machine. At the



suggestion of Alan Turing, Tony Flowers of the Post Office Research Station at Dollis Hill was called in and began to build the new machine assisted by other electrical wizards from his department. With the benefit of hindsight, the machine that was built can be seen as effectively the World's first true electronic computer, involving an array of initially about one and a half thousand valves (EF50) and thyratrons. In a second version this figure was to grow to about two and a half thousand valves.

These vacuum tubes and thyratron switches emulated the relatively slow rotation of the mechanical rotors of the Lorenz enciphering machine and the Geheimschreiber, but at a blinding speed for 1944. This later machine, known as 'Colossus', was capable of employing conditional Boolean logic and could be programmed like any modern computer. For this purpose a system of toggle switches and a plugboard was employed.

The main work of Colossus was to analyse the settings of the rotors in the German machines. However in order to produce plaintext from the ciphertext, another device was required. This was known as 'Tunny', derived from the cover name for all of the enciphered teletype traffic received from the Axis:

'Fish'. The Germans called this system the Sagefisch (Swordfish) and the code-breakers at Bletchley Park adopted a dangerously similar range of names, such as Tunny, Sturgeon and so on — but all grouped under the general name of 'Fish'.

What the Tunny machine was able to do was to emulate with conventional Post Office Type 3000 relays the actions of the Lorentz and Siemens machines, once the settings of the rotors had been established using the Colossus. Tunny received the stream of the enciphered Baudot and converted it into a stream of plaintext German, which then could be taken off for translation and distribution. Here was the source of the 'Golden Eggs' which Churchill referred to as coming from "Geese that never cackled".

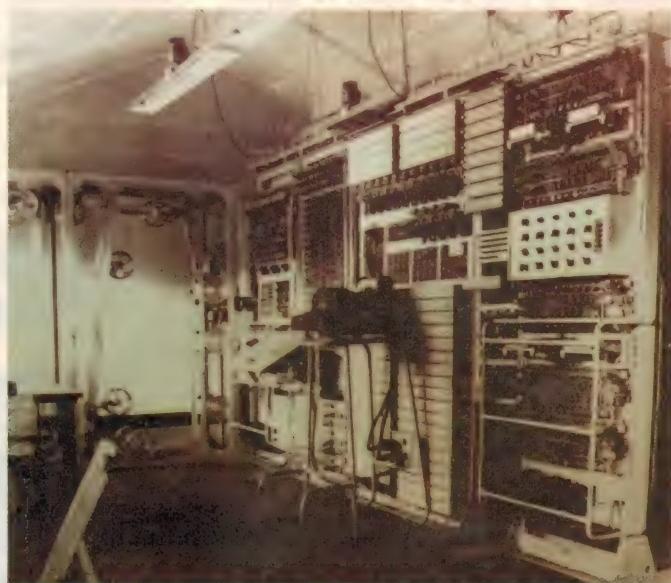
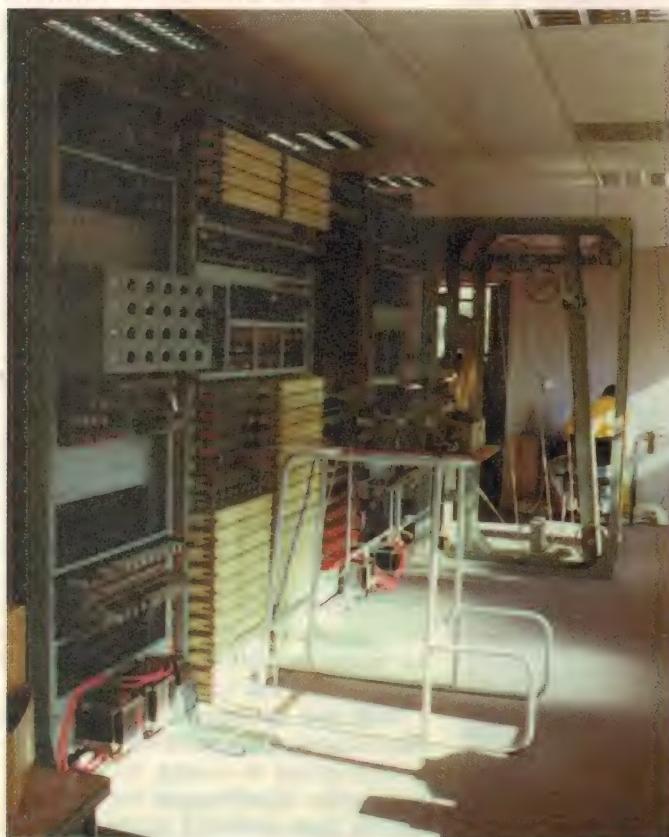
Reference to the photographs shows the 12' wide by 7' 6" high racks and panels of the Colossus being set up by women service personnel. The thyratron valves can be seen, as can the 'bedstead' paper tape pulley wheel and reader units. In the foreground is an IBM electric typewriter which had a conventional transverse carriage. This operated with such violence that the stand upon which it was mounted would walk across the floor if not restrained. It was usually 'roped' into position, adding to

the 'string and sealing wax' appearance of the whole construction. More importantly however, the apparatus worked and worked brilliantly.

Ironically at the end of the war, because of its secret application, the Colossus was dismantled completely and few photographs of the original installation remain available.

Only a few years ago that would have been the end of the story of Ultra and the extraordinary secret of the code breaking in the Second World War. However with the reopening of Bletchley Park a new and fascinating endeavour has commenced. This is the replication of the Colossus.

Based on particularly the efforts of Tony Sale, formerly the Curator of Computing at the Science Museum in London and now Executive Director of the Bletchley Park Trust, a replica of the Colossus is virtually complete. In October 1996 it was possible to see the finishing touches being applied to the new Colossus and the photographs that were able to be taken reveal the uncanny similarity of the new to the old. No doubt this is a result of access to persons who were involved in the construction of the original; but even so, it is a quite remarkable effort to recreate this extraordinary machine.



Above: The original 'Colossus' machine, developed in 1943 to analyse the rotor settings for the German enciphered teletype messages. Using about 1500 valves and thyratrons, it was arguably the world's first programmed electronic computer.

Left: The replica Colossus machine in the Bletchley Park Museum, pictured here last year when the author paid a visit.

The microcomputer museum area at Bletchley Park, which was still being set up in 1996. Although a little disorganised, it was fascinating for anyone with an interest in this area.



Bletchley Park Museum

In 1992, following the declaration of the Bletchley Park Estate as a conservation area by the Milton Keynes Borough Council, the Bletchley Park Trust was established and the job of making the establishment suitable for public access was commenced. Of the many personalities involved in this great regeneration, it appears that three in particular have been 'toilers at the coal face' — known as the 'Grand Triumvirate'. Roger Bristow was appointed by the Trust as General Manager, Tony Sale was involved as a consultant and later project coordinator and builder of Colossus, and Ted Enever as chief executive, public relations consultant and general factotum — formerly with the Milton Keynes Development Corporation.

In the relatively short period since 1992, an extraordinary place has been recreated and is rapidly being filled with new and interesting items and exhibits to illuminate the war years for a new generation of visitors. Quite apart from all the material and exhibits associated with the production of the Ultra information, the Bletchley Park Trust have also gone a long way to creating a museum of computing and communications. There are a number of quite fascinating exhibits of microcomputing, communications and armaments to be seen.

In the grounds, a collection of fine military vehicles is also being built up by the enthusiasts. This collection even includes a Centurion tank. While I was there, they had commenced the potentially long and difficult job or restoration of an army 'DUKW' which looked very much the worse for wear, with most of its side panels rusted through. A Scout Car complete with Vickers machine gun (deactivated) was another beautifully

restored exhibit, as was a Jeep complete with radio apparatus.

For any technically minded person, a visit to Bletchley Park to see the Colossus, together with all the other collection of artifacts is a treat that should not be missed. The only problem is having enough time to see all that is available and one suspects that more than one visit would be required to take everything in. It's rather like the Science Museum in central London — another 'must see' place for the overseas tourist.

Finally, my thanks are extended to the Bletchley Park Trust and to its Executive Director, for permission to take the photographs that hopefully will bring to life the written description of a quite fascinating place.

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Moffat's Madhouse...

by TOM MOFFAT



Big Brother IS watching!

Many of you will remember the Moffat's Madhouse column in December last year — a little love story about two people who met, and courted, via their company's e-mail system. It was the ideal solution for them; both the man and the woman were no longer young, both were a little shy, and had it not been for e-mail across the office, they most likely would never have got together.

Now, sad to report, the whole romance has fallen apart, or more likely has been sabotaged, in a rather distressing way. Not long after Christmas, the woman was called into the manager's office and reprimanded for unseemly behaviour with the man in question. A few days later it was the man's turn; the manager reprimanded him too, but as well he was told he could be facing a sexual harassment charge.

From the male point of view, this is scary stuff. In the USA, sexual harassment in the workplace has become big business with women being awarded up to \$US7 million in damages (that's close enough to \$10 million in Australia) against both the alleged harasser and the company for which they both worked. According to *Newsweek* magazine, sexual harassment actions in the USA have jumped from 6000 in 1990 to over 15,000 in 1996. The latest target is none other than President Clinton himself.

So, after his warning, our male participant in this office romance pulled his head in and went into full protective mode, avoiding all contact with the woman. Only a few months before, a teacher at a nearby high school had seen his life ruined by an (unproven) sexual harassment charge, and our man didn't want to be next.

The office romance had been conducted with total decorum; the couple made sure they weren't seen together even outside working hours. It was a very secret affair, known only to a few close friends, and to no-one in the

workplace. So why had the management suddenly started yelling 'sexual harassment'?

The answer only emerged during a chance, unexpected phone conversation between the man and the woman, during the time they were officially not supposed to be speaking with each other. Management had mentioned things, to both parties, which could have only been discovered by intercepting their e-mail.

My immediate reaction, upon hearing of the couple's plight, was 'big story'. This sounded like a most blatant invasion of privacy, and that's supposed to be a felony here in the USA, punishable by a long jail term. If these people sued, they could bring the offending company down to its knees. And it would bloody well serve them right — right? No.

As it happens, United States law does not prohibit employers from reading their employees' e-mail messages. And as far as 'right to privacy' goes, the Constitution only protects citizens against intrusion by government, not by companies. Talk about opening a can of worms! Permit me to quote from a legal opinion I found on the Internet:

Employees have only limited rights under the only applicable federal law, the Electronic Communications Privacy Act of 1986 (the 'ECPA'). This law prohibits the interception of electronic communications, and therefore provides protection for messages sent on on-line systems such as the Internet and CompuServe. However, the law contains a major exception: it permits employers providing e-mail access for employee use to inspect and disclose communications if the inspection is done in the normal course of business and is necessary for business purposes or to protect the employer's rights or property.

Wow! Just think about that for a moment. If you work for a company in the USA, and that company uses e-mail

(and most do), your employer has the right to intercept and read every word, every thought, you have sent by e-mail during your time with that company.

Another e-mail misconception: You send a message to someone. The message flows to the person's mail server and then sits there on the server's hard disk until the recipient logs on and checks for e-mail. Then the message is sent to the recipient's computer, and it's deleted from the server's computer.

This may not be the case at all. The mail may not be deleted, but simply moved to an archive where it is sometimes stored for up to six months. This is done, apparently, in order to cover the company in case of litigation. So not only can your employer monitor what you're up to *right now*, he can also monitor what you've been up to in the past few months...

Apparently it is now considered part of good modern management practice to routinely monitor employee e-mail. Justifications include catching employees who may be planning union activities against the company, exposing spies who may be revealing industrial secrets, trapping lovers who may be flirting on company time, or catching someone who is conducting some outside business activity over the company network.

Very easy

As a system administrator, I know it is dead easy, at least on a Unix system, to intercept any e-mail one cares to. You simply find someone's mailbox on the server, and then use a Unix editor named Emacs to read what's there. Should you find something interesting, you can search back through the mail archive to unearth other morsels.

Management guidelines I've read state that employers should warn employees that their e-mail is subject to monitoring. I even found a draft form for employees to sign, acknowledging that their e-mail is subject to

scrutiny as a condition of employment. But one wonders how many employees are actually informed about this. Our romantic couple certainly wouldn't have sent flirty e-mails to each other had they known their employer could be reading every word.

There is one key to this whole issue, and that is whether e-mail is sent over a corporate, or a public network. Looked at in its simplest terms, it is OK for a company's management to eavesdrop on e-mail when the network in question is owned by the company. But should the e-mail be intercepted from a PUBLIC network, then the eavesdropper has committed a felony.

Gave myself a fright

While researching this article, I managed to give myself a good fright, because the nature of my own employment seems to be a gray area. I work for an Internet Service Provider where employees conduct almost all communication by e-mail. So far, this is not much different from other companies.

But, since we are an ISP, we use the Internet, not a dedicated internal network. Our infrastructure is a computer network that spreads over several hundred square kilometres, and is usually thought of a 'public' network to which members of the public subscribe for a monthly fee.

However, from an employees' point of view, this entire network is owned by our employer. That's what we do for a living — provide the network. So the question arises: is our e-mail over this network, which is actually a part of the Internet, employee mail travelling over a corporate network? Or is it personal mail travelling over the public Internet?

I think the clincher here is the question of who pays for the accounts on the network. On a public network such as Compuserve or the Internet, the individual user pays, so the user can be considered the 'owner' of the account. But on a company network, accounts are provided free; that is, the employer pays for the account.

In the case of my own employer, our accounts are provided free, so the employer must 'own' the accounts. But in most cases, people who work for this company were paid-up subscribers before they became employees. Once on staff, the employer picked up the tab for the employees' existing personal accounts, and added some company-specific accounts as well. The newly added accounts are obviously 'work' accounts, but does

the fact that the employer is now paying for the existing personal accounts make them 'work' accounts as well? And are they thus subject to legal monitoring by the employer?

I'm certainly not alleging that my employer is monitoring my e-mail, or anyone else's. I am simply pointing out that he has the technical ability, and the legal right, to do so.

Readers who have been following Moffat's Madhouse over the years know that I tend to get worked up over issues such as freedom of speech and right to privacy. So I find this whole e-mail issue very disturbing from a philosophical point of view.

What can be done about it? I have, sitting on a bookshelf next to my desk, an orange and white box containing a software package called PGP, for 'Pretty Good Privacy'. This is a very advanced program, which has won world-wide acclaim, to encrypt files prior to transmission over a computer network. PGP is said to be just about un-crackable.

At present my 'personal edition' of PGP remains unopened. Up to now, until I started researching this article, I thought I had no need for it. I thought that people who used PGP were simply paranoid. But now — maybe I'd better open that box. I understand PGP has a hot following, particularly amongst human rights groups and others which may draw unwanted government attention for what may be seen as 'subversive' activities.

It is naive to consider any kind of e-mail secure. E-mail messages are handed from place to place on their journey from sender to receiver. In my case, between the USA and Australia, my e-mail is subjected to up to 16 relays, and it can be intercepted and studied at any one of those points.

E-mail has often been compared with sending a postcard through the snail-mail; anyone along the way can read it easily. PGP at least provides an envelope...

So far we've been talking about the situation in the USA, but what about Australia? This is interesting — my search through Australian resources has revealed lots of concerns about privacy, but no reference at all to e-mail. Here in the USA there are hundreds of documents on-line concerning e-mail.

One very encouraging thing about the Australian scene is that the government has a Federal Privacy Commissioner to keep an eye on privacy matters. I see a new Commissioner has recently been

appointed — Moira Scollay, who replaces the highly-regarded Kevin O'Connor. My last dealings with O'Connor were two or three years ago, while doing research on (would you believe) Pretty Good Privacy.

The big privacy issue in Australia, as this is being written, seems to be video surveillance in public places and in the workplace. It's interesting to see the American reaction to video surveillance. When it was revealed that TV cameras in Britain were watching the populace in malls and other public places, there was general outrage — "That could never happen in the USA! Our constitution would never allow it!" Yet the same American people are meekly accepting surveillance of their e-mail by their employers.

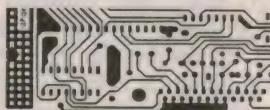
I think I smell a really good debate coming on. With the approval of our editor Jim Rowe, maybe it's time to thrash this out in 'Forum'. It's obviously something that badly needs airing, particularly since so little seems to be said about e-mail privacy in Australia. Maybe we can even involve the new Privacy Commissioner. Just make sure you don't send your submissions by company e-mail — and please, send NOTHING directly to me! ♦

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FORUM

Conducted by Jim Rowe



Another aspect of the EM fields/health debate: how safe are pest deterrent gadgets?

Predictably, the EM fields/health debate hasn't let itself be sidelined for long. So much material has arrived that it's clear I'll have to give it more space again. This month I'm lighting the touch-paper once again by presenting some material that has turned up on an aspect we haven't looked at previously: whether or not there's a health hazard associated with an 'electronic pest deterrent' device introduced to the Australian consumer market a couple of years ago...

Ever since the January and February issues were published, with their Forum columns discussing the thorny subject of EM fields and possible health concerns, I've been almost buried in correspondence and evidential material from all directions — and certainly from both sides of the dichotomy that's evident around the world in the scientific and engineering communities.

On the whole, I have to say that most correspondents seem to have been quite happy that a magazine like EA is trying to discuss such a difficult subject, and in a reasonably objective manner. There have been a few voices to the contrary, accusing us of 'media populism' and 'propagating ignorant scare mongering', but not surprisingly these have generally come from people working in either the electrical power distribution or cellular telephone industries. It's clear at least some people in those industries would rather that the rest of us didn't question any of their decisions or actions, and simply let them get on with making money...

One way and another I've also become aware that as a result of us trying to raise awareness and encourage more thinking about this subject, EA is very unlikely to get any more advertising from the power distribution or cellular phone industries. Which is an unfortunate fact of life, I guess, and it has inevitably made me wonder if I'm doing the 'right thing' — because small magazines like EA basically need all the advertising support we can get, and in the commercial sense an editor like myself is crazy to run anything which will upset a group of potential advertisers.

Mind you, we haven't had any significant advertising until now from the industries concerned, and to be realistic we probably wouldn't have received

much support from them in the future anyway. So I haven't had much difficulty in squaring my conscience — especially as the subject is very much one of 'public interest', and I believe EA's readers have a right to be able to make up their own minds, based on whatever factual and balanced information we can provide them.

There's also another consideration: if little magazines like EA, without much to lose from withdrawal of advertising by the industries concerned, aren't prepared to give it a decent airing, where *will* it get one? Not from the bigger publications with rather more to lose, I suspect...

Back into the fray

Anyway, with that preamble out of the way let's get back into the fray. With all the material that has turned up, it's been difficult to know where to start. However I thought what we might do this time is look at an aspect of the EM fields/health debate which we haven't discussed previously. It's an aspect that has been raised by reader Mr Bill Jackson, of Speers Point on the NSW coast, who after working in the technical side of radio and electronics retired about 15 years ago, and since then has been carrying out 'surveys' of people's homes to measure field strengths due to appliances, wiring and earth currents — at the request of both home owners, and in some cases their medical practitioners. He's apparently carried out over 1900 such surveys to date.

The aspect that Mr Jackson has raised on this occasion concerns those relatively recent arrivals on the Australian market, electronic 'pest deterrents'.

By way of background, you might recall that Peter Phillips published a letter from reader John Freeman regarding

one of these units, the 'Pest Free', in our January 'Information Centre', and expressed some doubt that it could work. Then in his March column, in response to letter from another reader reporting that the unit *did* appear to work, Peter qualified his initial criticism. Finally in the April issue, in response to some material and evidence supplied from the firm marketing the device, he suggested that the criticism may well have been unwarranted — the device does indeed seem to work.

So that's the background. In his own cover letter Bill Jackson says that unlike John Freeman, he doesn't doubt that devices like the Pest Free work. His concern is more that they are also a potential health hazard to humans, by virtue of the pulsed 50Hz fields they generate in the surrounding area.

He writes that this concern has arisen from his surveys of homes with the devices in use, and his observation of what he describes as 'the improvement in people's quality of life' when they are removed again. Here's an extract from one of his survey reports:

DETAILS FROM SURVEY C65:

Before the Pest Free was Installed:
Four year old son, good health and slept well.

Six year old son, good health and slept well. No school problems.

The husband, good sleep pattern and considered to be in remission for the previous six months from Lymphoma.

The mother, good health, reduced worry with husband's illness. A happy person.

Within two weeks of fitting Pest Free (Late February 1995):

Four year old son, sleep pattern altered, suffered nightmares and lack of sleep; hard to handle.



Six year old son, disturbed sleep, always tired.

The mother, becoming more stressed, loss of sleep and worried over family.

The husband had an unexpected flare up of his Lymphoma, preceded by lack of sleep. Admitted to hospital for five days treatment then returned home but sleep pattern still disturbed. He returned to hospital for more treatment. Returned home but again could not get a good night's rest. It was at this point that I checked out the house. (8.5.1995)

Detected the radiation and was then advised of the fact that they had a Pest Free device in operation. I immediately advised that they remove the unit from the premises. They agreed and requested that I take the device with me.

After the Pest Free was removed:

Within a matter of seven days the four year old went back to a good nightmare-free sleeping pattern and settled down.

Six year old also had improved sleep pattern.

The husband now able to sleep and in spite of the visits to hospital at this point feels much better and is aware of a 'different feeling' in the home.

The mother: "It's as though a heavy weight has been lifted off my head, the house feels completely different".

In the home no problems were found apart from a small amount of EMR from the water pipes and some of the electrical earth wiring. I advised that the small amount of EMR could be eliminated. At the time of writing this work has not been carried out.

This report extract was offered by Bill Jackson as food for thought, along with copies of the correspondence that has taken place between himself and various authorities, regarding his concerns regarding the pest deterrent devices. I thought we'd look at this correspondence as well, because it gives an interesting insight into the current state of thinking within bodies such as the Australian Radiation Laboratory, with regard to concerns expressed about EM radiation from equipment.

First of all, after contacting various researchers in this field around the world (including Professor Ross Adey), on June 15 1995 Mr Jackson sent this letter to the Secretary of the National Health & Medical Research Council:

Dear Sir

I have spoken with Professor R. Porter, the Dean of the Faculty of Medicine at Monash University, and he suggested I submit my concerns about this matter to you and your Council.

I have already seen the effects of this device on a family in this area (see attached report). I have expressed my concerns to many people in Australia and overseas who are aware of EMR problems on health. Their reactions were of disbelief and concern that these low frequencies were being pulsed.

Contact was made with a number of people in the United Kingdom and the USA, whose work in this field of EMR and health problems is recognised with respect. Mr R. Coghill, a Cambridge graduate specialising in Brain Function and the effects of EMR on the brain. In the USA I spoke with Dr Robert Becker, Consultant in Biomedical Sciences and Professor Ross Adey, a distinguished Professor of Medicine (Neurology).

All of these people expressed concern that this low frequency was being pulsed. When asked would they consider that humans could be affected, they agreed and considered a large number of people could experience varying reactions to the pulsed output. Professor Adey suggested I contact a past student of his here in Australia, Professor Robert Porter at Monash University; thus this letter.

It is considered the device is a serious intrusion of other people's privacy when

they are used in high rise buildings, shared housing, flats and units. It is a violation of the most fundamental human rights to impose a health risk upon individuals without their knowledge and/or consent.

While it is conceded that most people would not 'detect' these frequencies audibly, there is no doubt everyone would 'detect' those frequencies in their brain. In recent tests on a group of ten people, where the frequencies involved were reproduced from a tape recorder played at a low level, one developed quickened heart beat, and two headaches and nausea. The balance asked for the tape to be stopped as they were developing feeling of irritation and aggression.

The device is unlike any other electrical device ever produced for use in the home here in Australia. Unlike all other EMR emitting devices in the home this device was deliberately designed to be harmful and stressful to living things, and it is considered that the manufacturer of this device would find it very difficult to prove their claim that it is not harmful to human beings (or pets).

In 1985 Dr Becker wrote 'ELF Electromagnetic Fields vibrating at about 30 to 100Hz, even if they are weaker than the earth's field interfere with the cues that keep our biological cycles properly tuned. The results are chronic stress and impaired disease resistance.'

Quoting from Roger Coghill's book *Electro Pollution, 'In America and some other countries (The Power Lines for Household Use)* alternate at 60Hz, which is further away from the frequency at which our brains themselves oscillate all the time we are alive. In the case of 50Hz that frequency is very much closer to our brain frequency.'

Great interest is being shown by many people in this matter. I have been requested to keep them informed of the outcome of my submission to you. General opinion is that the public should be made well aware of the possible dangers to their health and wellbeing of a device that transmits pulsed frequencies of this nature.

I retired from a lifetime of working in the Electrical and Electronic servicing industry twelve years ago, and since then I have been investigating Electromagnetic Radiation and its effect on people's health in the home. Medical Doctors and Alternative Health Practitioners refer people to me and I have carried out in

excess of 1500 surveys in that time with highly satisfactory results.

I have concluded after all the homes I have checked that EMR levels as low as 2mg, (in some cases even less) can cause problems with many people's health. I feel the standards set here in Australia are very questionable, and if more in the home research were to be carried out I am sure a new approach to the matter of safe levels would result.

It appears that the NH&MRC didn't answer Mr Jackson directly, but instead passed his letter to the Australian Radiation Laboratory. In due course the following letter (dated July 21) arrived from the ARL's Dr K.H. Lokan, Chairman of the Radiation Health Committee:

Re: Magnetic fields and the "PEST FREE" device

I acknowledge your letter of June 15, 1995 to The Secretary of the NHMRC, which has been forwarded to me for reply.

In recent years concerns have been expressed through the media by the workforce and the general public in both Australia and overseas on the possibility that electromagnetic radiation exposure has an adverse effect on human health.

Many man-made electronic devices such as TV transmitters, radio stations, mobile phone base stations, radar installations, etc., are sources of radiofrequency radiation (RF). The possible biological effects of RF on man and the associated mechanisms by which RF may interact with biological systems have been the subject of extensive research for many years. To date, the only proven mechanism by which RF is known to cause harmful effects is by absorption of radiation which results in heating of tissue. Effects that stem from such increased heating of tissue are referred to as "thermal" effects. Other "non-thermal" processes such as effects on cell membrane permeability, or direct effects on chemical reaction processes within the body have also been proposed by various researchers. However, none of the "non-thermal" effects have been proven to occur to any significant degree in living tissue. Nor have such "non-thermal" effects been proven to result in injury to tissue.

The primary hazard arises from heating and excessive levels of RF can cause injury through overheating of tissue. The particular distribution of heating

will depend on the frequency of the RF, the orientation of the body within the field, and compensating biological effects such as blood flow cooling within the body.

The "PEST FREE" device has been tested at the Australian Radiation Laboratory and a copy of the brief report is attached. It is evident from the report that we do not consider the device to be a potential human health hazard.

Attached to this letter was the following report:

"PEST FREE" Radiated Magnetic Fields Test Report

The device was plugged into a length of 240V AC extension lead, turned on and allowed to operate. A calibrated loop antenna was positioned close to the power lead to measure the level of radiated magnetic field. A level of 4.4mA/m was measured at a frequency of approximately 10kHz, the radiated signal had harmonic components that extended beyond 100kHz but quickly became negligible. At 50kHz the level was 0.3mA/m and at 100kHz the level was 0.01mA/m.

The draft Australian Standard DR95900 for RF EMR exposure limits recommends a maximum permissible limit of 730mA/m for members of the general public. This limit is for the band of frequencies 3kHz to 100kHz and covers the "PEST FREE" emissions. The "PEST FREE" device emitted a signal that was intermittent with quite a low duty cycle.

At 3cm distance the highest level was more than 160 times below the Draft Standard. At 30cm from the device, the radiated level had become negligible. By way of comparison the device when radiating and measured 3cm away had the same level as a VDT measured 200cm away. The device is not considered a RF EMR safety hazard!

Michael Bangay
Senior Technical Officer
Non-Ionising Radiation Section
13 July, 1995

As you can see, it's pretty clear from their letter and report that the ARL didn't believe there was any significant health risk associated with the Pest Free. However Mr Jackson noted that there was no mention in their test report of any measurements below 3kHz, whereas he and other people had found low-frequency radiation at levels which gave them concern. Accordingly he sent back

the following reply, addressed directly to Dr Lokan:

I acknowledge receipt of your letter dated 21st July 1995. Wide distribution of the contents was made to interested parties after gaining permission from one of your colleagues. All are extremely surprised at the conclusion you reached in the last sentence of your letter, and the way the unit was appraised.

The main concern regarding the Pest Free is that the 50Hz from the mains supply is being pulsed at approximately 250ms 'on' and 250ms 'off' for a duration of 2-1/2 minutes on and 2-1/2 minutes off. The radiation from the unit itself, that is the solenoid coil, is extremely high.

The range of frequencies shown in the test report have never been a problem, and I did not raise this issue. They would have, by their nature, been extremely low level output. The frequency radiation from approximately 400Hz down is a different matter, but these low frequencies were not mentioned.

Scores of tests by interested groups and researchers all showed up this aspect of the Pest Free. I check homes on the recommendation of medical doctors as well as the wider field of the alternative medical practitioners.

Sample readings

The following are readings taken with a Gauss Maus, set up at a fixed distance of 12 inches from each of the following appliances: bedside radio, radio cassette player, cassette player and the Pest Free. The sensor was targeted on the power supplies and, in the case of the Pest Free, the solenoid coil, and they were orientated to give the highest readings:

Bedside clock radio - 2 Mg

Radio cassette player - 2.5 Mg

Cassette player - 1.5 Mg

The Pest Free (in the pulsing mode) - 23 Mg, and in the off mode 5 Mg.

My past experience in this field leaves no doubt in my mind that the pulsed 50Hz output of the Pest Free is a potential health hazard and people should be made aware of this fact. I have never claimed or suggested that the unit should be banned, but it should carry a warning.

I wish to record my thanks to Mr M Bangay for the courteous and understanding way he has reacted to my concerns and point of view during a number of phone calls with him. I cannot prove (scientifically) that the low frequency emission from the Pest Free caused health problems with humans, but from what I have seen with equipment of

much lower output, which has affected people, I am more than concerned with the levels from the Pest Free.

Do you have undisputed scientific evidence that the Pest Free is indeed safe? It appears you based your conclusions on a unit that had been tested for any frequencies other than those covered by DR95900 being 3kHz to 100kHz. We must conclude that any frequencies under 3kHz were overlooked.

We consider that, had the conclusions of Sir Harry Gibbs contained on page 57 of his 1991 report, paragraph 5-11-1 been taken into consideration, perhaps a more balanced judgement would have resulted. In simple terms he says "It has not been scientifically established that it is harmful and it has not been scientifically established that it is not harmful".

I will put on hold our plans to take this matter further, until 8th September 1995 by which time I feel sure you will be able to have another look at this matter and advise accordingly.

In response to this new letter, Dr Lokan in turn sent the following reply:

In response to your concern expressed in your letter dated 22 August 1995 regarding the pulsed magnetic fields emitted by the Pest Free device, I would like you to consider the following:

Fifty Hertz (Hz) magnetic fields in a home environment are rarely stable and are more likely to be randomly pulsed. This is caused by the changing 50Hz current levels both in the home and street wiring circuits as home appliances are turned on/off. ARL measurements using continuous data logging techniques show residential magnetic fields to be constantly varying, largely because of currents external to the home (e.g., in street reticulation).

To my knowledge nobody has shown that random pulsing is any more potentially dangerous than regular pulses. Some animal studies using signals modulated with frequencies about the same as brain EEG pattern frequencies altered brain activity in the exposed animals. The experimental work was limited to using RF carriers modulated by frequencies between 1 and 60Hz.

At the present there is no scientific evidence that ELF magnetic fields are dangerous at low levels, let alone that pulsed fields are dangerous. While the issue is still unclear, nobody can say at what frequency/pulse rate/level fields may be dangerous, at best I can only say: "if concerned don't use it".

I don't want to dismiss your concerns, but it is quite difficult to deal with anecdotal concerns however important they may appear to be; my position requires

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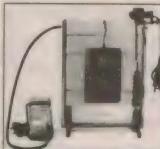
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me to approach issues with a scientific discipline that rules out or minimises the possibility of a false result. Your concerns would be best undertaken by a research team working in conjunction with a university, perhaps funded by the ESAA. I encourage you and your colleagues to give consideration to initiating suitable scientific investigations.

As you can see, Dr Lokan seems to be unwilling to comment on whether the ARL carried out tests on the unit below 400Hz, and contents himself with a suggestion that any low frequency emissions from the device are likely to be of little or no concern in terms of human health.

Needless to say Mr Jackson was still not very happy with this response, and made this clear in his final missive dated November 7, 1995:

Dear Dr Lokan

Your letter of the 20th October 1995 to hand and I express disappointment and concern about its contents and tone. Once again you have not addressed the subject. Your technical remarks were completely irrelevant and to be advised by a Director of the A.R.L. "if concerned, don't use it" is considered incredible and questionable.

There are many questions that could be raised as to the way this matter has been handled. I was advised that Mr Bangay did encounter the strong ELF radiation the device is pumping out, but for reasons over which we can only surmise they were never mentioned. So be it.

With respect I consider you made an error of judgement in deciding that

the device was not a hazard to human health, and flies in the face of your remarks in paragraph 3 that "nobody can say, etc etc". Researchers here in Australia, the United Kingdom and the USA do not support your claims, nor do I.

I respectfully suggest you read again all the correspondence concerning this matter, and feel that by applying the well thought out and sensible approach to a matter of this nature as set out in the Gibbs Report in Conclusion 5-11-1 should be given serious consideration.

To conclude this letter, Mr Jackson quotes the Conclusion from the Gibbs Report, presumably in full:

5-11 Conclusions

5-11-1 It has not been scientifically established that electric fields or magnetic fields created by the electric power system in New South Wales (or by any electric fields or magnetic fields of extremely low frequency) initiate or promote cancer or have any other harmful effect on humans. However, it has not been scientifically established that such fields are not harmful.

Hmmm. I'm inclined to agree with Mr Jackson, that this sums up the situation rather well. Aren't you?

I guess one of the things I personally found most interesting about the ARL's responses to Mr Jackson's correspondence was the emphasis they seem to place on the claim that as yet, no one has supposedly proved that there are health risks associated with non-thermal levels of EM fields. I don't know about you, but somehow this emphasis seems to reveal a lack of full scientific impartiality.

Perhaps I'm still a bit naive, but I would have expected that if bodies like the NH&MRC and the ARL had any bias at all, it would have been in the direction of taking a 'prudent minimisation' approach to anything that could possibly have an adverse effect on human health. In other words, one of 'suspect until proven innocent' rather than 'innocent until proven guilty'. The sort of approach that is taken towards new drugs, for example — ensuring that they're very carefully and thoroughly tested before being released for general use.

I guess the other thing that struck me about the ARL's position was that suggestion 'if concerned, don't use it'. That seems a remarkably glib and unconcerned approach to the safety aspects of any device, don't you think? Especially when as Bill Jackson pointed out, the field from a pest deterrent device could easily embrace the living space of people other than the person nominally 'using it' — in places like apartment buildings and semi-detached homes, for example.

Regardless of whether or not Bill Jackson is right about there being potential health problems for some people from radiation produced by devices like the Pest Free, the attitude of the ARL to such questions does seem rather inadequate. Wouldn't you have expected something more, from experts apparently charged with looking after public health, than simply offering the view that a new device is 'innocent until proven guilty', and merely suggesting to consumers 'but if you're concerned, don't use it'? ♦

What will PC's be like in 2047?

(Continued from page 22)

University of Illinois in Chicago, uses an imaginary three-dimensional space (about 10 x 10 x 8 feet) in which each XYZ coordinate is associated with a musical sound from a variety of instruments. By moving a sensor at the end of a cable through this 'musical space', sounds are generated. Someone who knows exactly where each sound is located within the space, can produce conventional music. "It's kind of like learning all of the keys on a piano or electronic organ", said a Vibespace engineer demonstrating the system.

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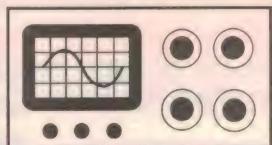
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THE SERVICEMAN



When you could fix a set with a wet finger and a screwdriver!

Our first story this month comes from a reader who describes from first-hand experience how radio sets were repaired back in the 1920s — fascinating! We also have a story about repairing a laptop computer power supply/charger, which although well made was like a lot of modern equipment: built to sell at the lowest price, with little or no provision for servicing in the event of a fault. To finish up, we look at tracking down a fault in an elderly Akai VCR...

This month we open with one of the most interesting anecdotes I can ever recall us presenting in these pages.

I must admit that when the story first arrived, I was tempted to dismiss it as a hoax. I mean, anyone who can recall repairing radio sets 75 years ago simply had to be getting close to 90 years old — even assuming that he started in his mid teens!

In fact, I was so incredulous that I asked our Editor Jim Rowe to check the writer's credentials. It so happens that our contributor checked out with an impeccable pedigree, and as a result I am pleased to present here a first-person account of the earliest servicing techniques ever to appear in these pages.

Our venerable contributor is 86 year old Mr Lionel Cohen, of North Bondi in New South Wales. Mr Cohen began

servicing 'wireless sets' when he was 'just a kid', and has been a regular reader of this magazine, and its predecessors, since the first issue of *Wireless Weekly* back in 1922...

So it's with great pleasure that we present Mr Cohen's recollections of servicing radio sets in the early 1920s:

Having read 'The Serviceman' for so many years, I thought it might be interesting to readers to hear about how we serviced the 'wireless' some 75 years ago.

The sets I knew then were wired with heavy bus-bar on a wooden base-board, with a Vulcanite (hard rubber) front panel. In those days capacitors were called 'condensers' and their capacity was measured in 'Jars'. Valves were usually 'bright emitters', and lit up the room more brightly than the bulbs in our overhead 'chinaman's hats' lampshades.

There were only three operations needed to service a set in those days — the 'tighten up' procedure, the 'spark test' and the 'wet finger test'. The only tool required was a screwdriver, hence the term 'Screwdriver Mechanic'.

The tighten up procedure was carried out first, to ensure that the ends of all bus bars were firmly fastened and to see that the plates of the variable condensers were not loose and touching.

If the valves had 'R' type bases, they should be firmly seated. If they had 'UV' bases, the sockets were always suspect. Their contacts could be dirty or had lost their tension. If the valve still failed to light, the filament pins would be connected directly across the 'A' battery, with a rheostat in series for safety if necessary.

At this stage the A battery, usually a big heavy lead-acid one, was given the 'spark' test with a screwdriver. It

wasn't recommended to do this test with a table knife because it left big nicks in the blade!

It was sometimes convenient at this point to give the spark test to the B batteries, each of which was rated at 45 volts and could produce quite a good fireworks display if it was in reasonable condition...

If everything seemed OK but there was still no sound, the 'wet finger' test would be applied. The procedure was to lick one of your fingers and touch the grid terminal of the last audio valve. If a plop or hiss was heard in the headphones, then that stage was working. Each valve was checked like this in turn, working back towards the aerial.

If there was still no solution, then we applied the more drastic action of applying the spark test between the plate terminal and the filament supply bus bar, using the everpresent screwdriver. If this didn't reveal the faulty area, then three options remained... One: ask your local motor mechanic for ideas;

Two: ask family or friends if they knew of someone who had repaired a faulty set; and,

Three: put it aside and await Divine inspiration.

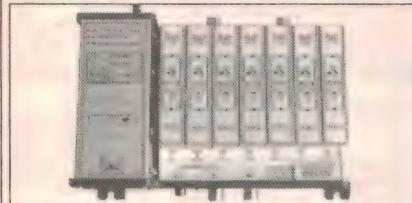
That's how we did it, seventy five years ago.

Ah! If only it was that easy today, Mr Cohen. And yet, the procedures just described were not all that different to those used as late as the 1950s and 60s. I can remember using much the same techniques on four and five valve mantel radios — spark test, wet finger test and all. The technique was even legitimate in some sections of a valve-type television set!

Thanks for that contribution, Mr Cohen. It's as well that we remember

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the pioneering days, and you have certainly brought those times to life.

Incidentally, can anyone remember the 'chinamans hat' lampshades mentioned by Mr Cohen? They were a flat conical shade made from white glass. I hadn't seen them in use since my childhood, until recently when I spotted coloured plastic versions in a cheap-jack store. They certainly established a distinct time-zone for Mr Cohen's story.

Repairing a laptop

Now, by way of contrast, we will take a quantum leap into what was then Mr Cohen's future and take a story about modern miniaturisation — in detail, a laptop computer. The story comes from Mr Brian Knight, of Evandale in South Australia.

As it happens, the theme of Brian's story is something dear to my heart — I abhor the present 'throw-away' society. I don't mind admitting that in recent years, as I approached retirement age, I spent many unprofitable hours salvaging customer's chattels that should really have been junked. It's just that I couldn't bear to see otherwise useful items thrown away, because of a simple but inaccessible component failure.

I know I would certainly have followed the same path as our contributor. Would you? Brian calls his story 'Repairing A Laptop Power Supply':

I am not really an electronics serviceman, it's just that I have a strong hobby interest in electronics. My real work is as an auditor, evaluator and data analyst, in the education and training fields.

As part of my work, which takes me all around the country, my employer supplies me with a laptop computer to enable me to undertake data collection and analysis while on the road.

The laptop I use is a Digital HiNote, model CT475, which has quite an impressive specification (at least it WAS impressive, when it was bought two years ago!). Despite a number of rough landings (courtesy of taxi drivers, and passers-by tripping over cords), the HiNote has given very reliable service.

However, during last year I realised that the external 15V power supply, which connects to the laptop via a length of figure-8 wire and a standard plug, had become intermittent. Like so much equipment these days, this power supply is a totally sealed unit with no provision for servicing.

I realised that wiggling the output lead usually restored things to normal, suggesting that the fault was a break

somewhere near the point where the flying lead exits the housing. Eventually, though, no amount of wiggling or shaking would bring the power supply to life.

Fortunately, I had been able to keep things running until my travels for the year were over, and my dependence on the HiNote was reduced. On the odd occasion that I did want to use the laptop, I called into service a home-built power supply based on a 2A/15V transformer and a trusty 7815 regulator.

The regulator did run quite hot and when the internal lithium carbide battery pack was being charged at the same time as the computer was being used, the 7815 occasionally even shutdown. However, it did the job...

When I enquired about a replacement power supply at the local Digital distributor, the initial response was "Oh! That's quite an old model. We don't stock spares for those any more". The thought that an expensive and quite classy piece of computing equipment was being written-off as 'quite an old model' after just two years was interesting in itself.

Fortunately, the distributor gave me the name of a third-party spares supplier, who indicated that a replacement was available and would cost about \$70 plus tax — not too bad, for what I subsequently found out was a switch-mode supply rated at 2.4A. No wonder the 7815 regulator in my makeshift replacement sometimes got a bit hot under the collar!

But instead of spending \$70 plus on a new power supply, I wondered

No amount of prising or other encouragement would separate them.

Eventually, I bit the bullet and cut along the seams of the plastic housing with a hacksaw. A slight twist with a screwdriver inserted into the saw cut snapped the two halves apart, to give me access to the PCB inside. It was one of the most tightly packed boards I had ever seen, and clearly not designed with servicing in mind.

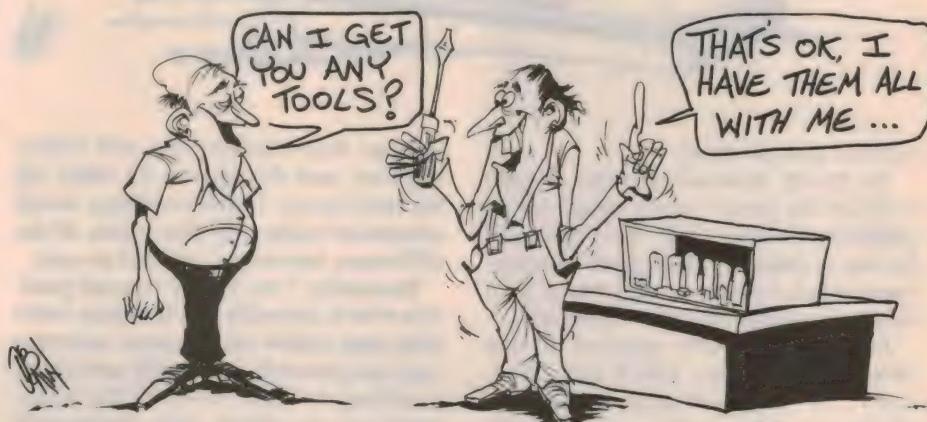
However, I located the pads on the PCB where the 15V was taken off and checked the voltage. Nothing! That ruled out the broken lead theory. One of these pads was fed via a small component which looked like a 1/4W resistor, although in situ it was impossible to tell what it really was.

Measuring the voltage at the other end of this component showed 15.35V. Bingo — I had located the fault!

So out came the soldering iron to remove the offending item. As I did so it separated into two pieces and I realised that it was a miniature, solderable fuse. It was labelled LF5A, which I assume meant five amps. Under a magnifying glass it looked like a standard miniature glass fuse, not one of the slow-blow or resettable types. Whether the fuse had blown or failed mechanically, I can't say.

Clearly, with everything packed in so tightly, wiggling the lead had moved the fuse sufficiently to make a temporary connection. But I was very puzzled by the logic of the design.

That the fuse was necessary to protect both the power supply and the computer I fully acknowledge. On the other



whether the old one could be repaired, since the symptoms suggested a mechanical rather than an electronic fault. Getting it apart would be the hard bit, as the power supply was encased in a moulded plastic box with the two halves fused tightly together.

hand, flying leads are notorious for receiving accidental shorts, which would blow the fuse. To locate such a fuse inside a totally sealed power supply unit seems rather daft to me.

Elsewhere on the PCB I noted a another fuse, a standard 2AG clip-in

THE SERVICEMAN

type. Locating this fuse inside the sealed case is more understandable, since it is connected in the 240V AC line and it would only blow if there were a very serious fault in the power supply unit.

To repair the unit, I could have replaced the blown fuse and reinstalled the PCB in its original case, glued together with Araldite. However, if the replacement fuse ever blew I would have the same problem all over again. And once set, Araldite is very difficult to remove...

Instead, I bought a small plastic jiffy box at a local electronics shop and installed the PCB in that. It was almost a perfect fit. Moreover, there was just enough room to install a panel-mounted 2AG fuseholder to replace the miniature soldered fuse. This would enable the fuse to be replaced from the outside if it blew again. I was also able to do the job without using metal screws. This was important for safety reasons as the power supply is a double-insulated type,

I do agree, Brian. I do SO agree! Nine months ago my wife bought a quite nice Steam and Dry iron. It was a medium priced item, but it only lasted six months before the steam pipes clogged up and it stopped working. The service depot made no attempt to clean the pipes.

The iron went straight into the junk bin, and a brand new replacement was issued from stock. Yet for a dollar or two extra, the designers could have been made the iron more serviceable and there would have been no need for a replacement. (And there would have been a job for a Serviceman, too!)

Of course, consumers themselves are responsible for the 'throw away' economy. By showing a distinct preference for the lowest possible price, consumers have encouraged manufacturers to seek the cheapest possible construction methods — which in turn lead to the non-serviceability of low priced products. As in Brian's case above, welding the plastic housing closed is

Early Akai VCR

And so from old-time radio servicing, via microcomputer power supply servicing, we move to something like typical present-day servicing with a story from Wayne Scicluna of Kogarah in NSW. Wayne writes about an early Akai video recorder, a beastie that has never been among my favourites. I've had a lot of trouble with the microprocessor Syscon in these models.

Wayne, on the other hand, had a relatively easy problem with the analog circuits. Here's what he has to say, in a tale he calls 'A Strange Fault In An Akai VS-3EA VCR':

It all started when an ex-serviceman colleague (who now maintains radio communication systems) asked me to 'take a quick look' at his old Akai VS-3EA VCR, as he had more pressing demands on his time. This machine, he told me, had a peculiar fault: every so often, its playback picture on his TV would lose vertical sync and roll uncontrollably.

I secretly shuddered, as I'm aware that faults in these old Akai VCRs are rarely straightforward — and this one was to prove to be no exception.

On the bench and with the main PCB swung clear of the beast's innards, it performed flawlessly. But just as I was about to turn my attention to more immediate bread-and-butter jobs, sure enough the picture began to roll intermittently, although I could see no visible degradation of the image.

Hastily I stoked up the CRO, clipped its probe to the video output socket and carefully studied the waveform. I didn't immediately see anything unusual, but just as I was beginning to suspect a timing problem, the penny dropped: although the luminance component was stable, the sync pulses themselves were erratically varying in amplitude!

How could this be, I pondered, since the luminance signal and the sync pulses all leave the tape as the one composite signal? It was time to break out the service manual which my colleague had thoughtfully provided, and over a welcome cuppa, study the luminance chain circuitry.

Back at the bench I began by examining the waveform at TP26, the output of the playback Y (luminance) emitter follower, and sure enough the sync pulses were visibly varying at this point. Next I did some voltage and



without a mains earth.

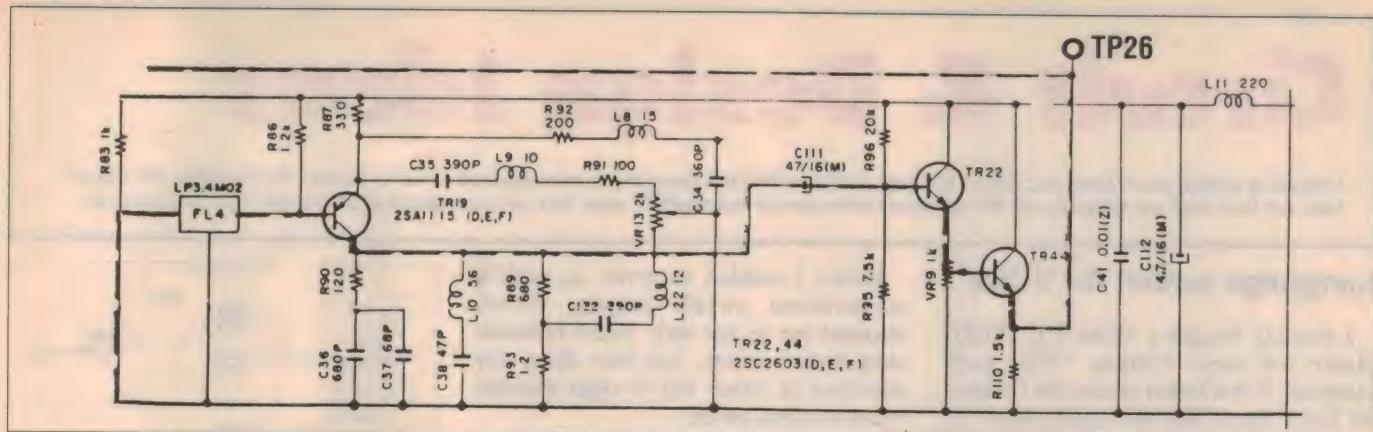
On strictly economic grounds, the job I did on the power supply could not be justified. However, I do have the satisfaction of knowing that a piece of equipment which had only a very trivial fault has been saved from the scrap heap.

In general, I am opposed to the throw-away culture which has developed in many hi-tech industries. Perhaps with small, comparatively cheap items such as laptop power supplies it does not matter so much. However, I do think that designers need to think carefully about the most likely sources of failure before they encapsulate a piece of equipment, fuses and all, inside a welded plastic housing that makes normal servicing impossible.

cheaper than screwing the two halves together, and this shaves 15 cents off the retail price! In the cut-throat world of modern marketing, that makes all the difference between a sale and no sale.

Personally, I try to buy top-end products which generally last for many years with only regular maintenance, and even then can generally be readily serviced if ever they do break down. In the meantime, we are faced with worthwhile products like Brian's power supply, which are worth fixing but constructed so that the job is almost impossible.

Fortunately, as Brian found out, jiffy boxes can encompass a wide variety of manufacturer's sins! Thanks for the story, Brian, and we look forward to more along the same lines.



Part of the luminance chain of an elderly Akai VS-3EA video recorder, which forms the subject of Wayne Scicluna's servicing story. The sync pulses were varying wildly at TP26...

waveform checks around TR19, which feeds the video 'sharpness' control circuit; but I gave this stage a clean bill of health.

I knew I had to be getting close to the culprit now, so I clipped the CRO probe onto the signal end of R96 (TR22's base) — where once again I observed a clean luminance signal with good healthy sync pulses.

But on TR22's emitter it was a different story. Here the sync pulse amplitude was varying in fine style. So that had to be it, I thought: TR22 was intermittent. Having no 2SC2603's readily to hand, I found a BC548, soldered it in, and switched on in expectation of a complete cure.

I could scarcely believe it when the playback picture came up rolling as badly as ever! The DC voltages around TR22 and TR44 measured close to the mark, and for a while I had to admit I was stumped. I reasoned that if TR22 was not faulty then it could only be some sort of intermittent fault in VR9 its emitter load; but measurements with an ohmmeter showed nothing abnormal.

By now I was beginning to wish that I, too, was no longer in the servicing game. So in frustration I reefed TR44 out and replaced it with the SC2603 which until recently had served as TR22. Imagine my surprise when the picture came up as clean and as stable as any I'd seen from a VS-3!

So TR44 was the culprit after all, but why? Tests with the ohmmeter soon gave the answer — this transistor had a very large amount of leakage from collector to base, and the resulting current flowing into VR9's wiper was causing TR22 to cut off during the 'negative' sync pulses. Well! We all live and learn!

As for the VS-3EA, after a quick touch-up of VR9 and a bit of cleaning of the heads etc, this old warhorse pro-

duced a first-class picture and needless to say, my colleague was delighted with the end result.

Well Wayne, you might not believe this, but that was probably the easiest VS-3EA repair I have ever heard of! As I said at the beginning, those early Akai's had the most complex system control and any fault required that you first had to master the Syscon before you could even turn the machine on...

I still have four of those machines in my workshop, abandoned by their owners when obscure faults consumed too many hours of servicing time. I don't doubt that the faults are as simple as your leaky transistor, but *finding* them is a nightmare I can do without.

Thanks for your story Wayne, and I hope you have many more jobs as straightforward as that one.

Filling a vacuum

Now to finish this month, we have a short anecdote from our New Zealand contributor Peter Lankshear. In some respects this story harks back to that of Lionel Cohen at the head of this month's column, because it's about valves and fixing valve radios. Peter calls it 'Hollow State Problems':

I am pleased to say that I haven't encountered blatantly dishonest workmanship from professional servicemen, but I am quite often confronted by modifications that have come from the period when technology was changing from 'hollow state' to 'solid state'.

During the 1970s, valves were increasingly hard to find, but customers were still bringing their radios to servicemen who probably spent most of their time wrestling with monochrome TV sets.

A common problem with these radios was a faulty rectifier. Rather than waste time and effort chasing around for a replacement valve,

which everybody 'knew' would be no longer obtainable, the overworked technician treated the problem as he would have a TV receiver and slapped in a couple of silicon diodes.

This was an obvious approach to a simple problem, with the set back to the customer with a minimum of delay and expense.

However, as silicon diodes are much more efficient than valve rectifiers, the receiver HT voltage and consequently, the current drain, was then considerably greater than its designer ever intended.

In sets that have survived this treatment, I have measured as much as 350 volts on the anodes of valves when it should be a maximum of about 250. The consequences are usually a 'cooked' output valve and a puddle of wax under the overworked power transformer.

Of course, silicon diodes can be used, but only with the addition of a heavy-duty series resistor to reduce the rectified voltage to normal. The irony of the situation is that, with today's vintage radio network of contacts and sources, it is easier to find valves now than it was 10 or 15 years ago!

Thanks, Peter, for that little reminder of a once common problem. I recollect that I myself was once ignorant of silicon technology and perpetrated the very modification you describe. Fortunately, a long soak test revealed my error by way of a plume of smoke from the transformer.

I solved the problem in the manner Peter describes, but it was months before I could find anyone who could explain just what I had done wrong. Moving from 'hollow state' to 'solid state' was a really long learning curve for some of us.

Thanks for that item Peter, and I hope we can have more from you soon.

And that's all for this month. We have still more contributor's items lined up for you next month. 'Bye for now. ♦

Circuit & Design Ideas

Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

Language switch for VCDs

I recently bought a Video CD (VCD) player and some Chinese VCDs from overseas. When I tried to play the Chinese VCDs, I found that the manufacturer of the VCD had encoded different languages into both right and left channels of the audio track. In many cases I found that the right channel was in Cantonese while the left channel was Mandarin. Needless to say, the results from a stereo player were cacophonous to say the least. With English or single language VCDs, however, it was not a problem.

Simple temperature sensor gives linear output

This circuit was designed for making temperature readings in various parts of a house in Darwin, over a period of several days.

Each of the four temperature sensors (S1 to S4) were made from five series connected transistors, each with their base and collector shorted together. This configuration gave a very linear performance when measured over a range of 0

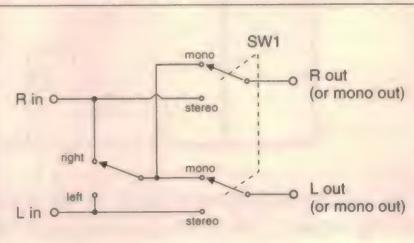
Hence I needed to come up with a stereo/mono switch selector which allowed me to not only select between stereo/mono mode, but also allow for selection of either left or right channel input in mono mode.

The circuit shown allows for selection of audio from the VCD player in stereo mode, or in mono mode where either the left or right channel audio can be selected as the input. Stereo/mono mode selection is via SW1, a DPDT switch, and while in mono mode the output can be selected from either the left or right channel via switch SW2.

- 50°C, and gave results to within 0.4°C of a laboratory thermometer.

For good results it is essential to match the transistors so that all outputs are the same at the desired zero setting. This can be done by measuring the resistance of the emitter to collector/base junction for each transistor and grouping each lot of five transistors so that the sum resistance is the same for each group.

The outputs of the circuit can be monitored directly, or logged (as in my case) on a computer using a suitable interface



The whole circuit has been built into a jiffy box and I can view my VCDs in the language of my choice.

Cheong Y Koo
Endeavour Hills, Vic. \$25

such as as the Dick Smith K-2805 parallel port interface.

As with most other interfaces, the input to the K-2805 interface must be between 0 and 5 volts, so a bit of calibration is in order.

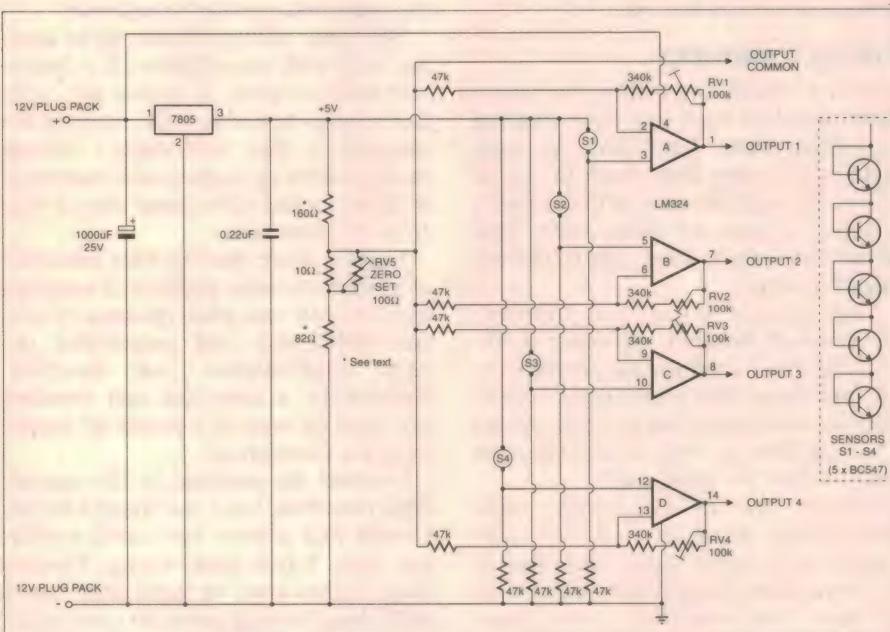
The sensors were placed in water at 0°C and the RV5 ZERO SET adjusted to 0 volts on output 1. Then the outputs 2, 3 and 4 were read and found to be within 0.15mV (150µV) of zero, which corresponds to 0.15°C and is 'near-nuff' as the Cornish say.

The sensors were then put in water at 50°C and outputs 1 to 4 set to 5.00 volts through adjustments to RV1 to RV4.

Set up in this way the output voltage multiplied by 10 is the temperature in degrees Celsius, which is very convenient for calibration using a voltmeter and thermometer. It is also entirely appropriate for measuring ambient temperatures in Darwin. However the circuit can be set for a different range of temperatures very simply.

For example a range of minus 10°C to plus 55°C required a thermometer that reads to minus 10 degrees and something that remains liquid at that temperature to put the sensors in. Methylated spirit in the freezer seems to do a good job; Set RV5 ZERO to 0 volts on output 1 and check the rest. It is likely that an adjustment to the resistors marked with an asterisk will be required. You can then set the four outputs to 5.00 volts at 55 degrees. The voltage/temperature relationship will then be $(V_o * 14) - 15$ in degrees C.

J.P. Sheehan.
Casuarina, NT \$30



WIN OUR 'IDEA OF THE MONTH' PRIZE!

As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a compact CCD video camera module from sponsor Allthings Sales & Services, offering 460 TV lines of horizontal resolution and 0.05 lux sensitivity, and valued at \$199.00!

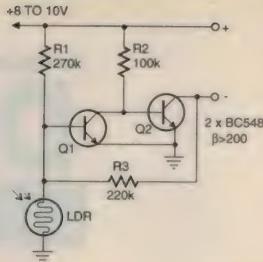
Light activated switch

Recently the need arose for a battery powered circuit of mine to switch itself off at night, to conserve power. I developed this circuit, which can be applied to any 8 - 10V low power application.

Q1's base is tied to a voltage divider formed by R1 and the LDR. When light falls on the LDR its resistance drops, and Q1's base is pulled low. As Q1 starts to cut off, the voltage on its collector slowly rises, which in turn switches on Q2. The moment Q2 starts to conduct, its collector pulls low and positive feedback is applied via the 220k resistor to the base of Q1. This action

rapidly toggles Q1 into full cutoff (effectively a Schmitt trigger action). Q2 subsequently turns fully on, ensuring a fast and clean switch-on for the load.

The hysteresis depends largely on the beta of the transistors and the amount of feedback applied. A lower feedback resistor value increases hysteresis and thus the switching speed. The resistor values are optimised for a load drawing no more than 4mA at 8 - 10V, but the circuit can be easily modified for lower voltages or higher loads by reducing the resistor values proportionally. The switch on light level can be adjusted by altering R1 (which can also be adjusted to accommo-



date different LDRs). The circuit's current consumption in the off-state is a miserly 140uA, with the values shown!

Manfred Schmidt
Edgewater, WA \$25

Parallel Port Servo Controller

This circuit was designed for controlling a servo motor using the PC's parallel port, and I have found it useful for doing robotics experiments at home. The servo is the standard three-wire type used in model planes and cars, where the servo control is achieved via pulse width modulation (PWM).

Most of these types of servos require a 50Hz clock, whose pulse width varies from about 0.5ms to 2.5ms. This range of values usually gives control over the servo's limits. This circuit gives you 256 different positions over the full range of the servo, which should be more than enough for most applications.

The circuit is based on two clock sources and a countdown timer. The first clock is based on a 555 timer and provides the 50Hz signal. The pulse width of this signal is the minimum pulse width (0.5ms) needed by the servo. This value

may be increased or decreased depending on the particular servo used, and this can be achieved by varying the value of R1.

This signal is then used as a gate control for the 100kHz clock signal produced by the second 555. This gated signal is used to supply a clock to the countdown timer consisting of the cascaded 74LS193's. A 100kHz signal is needed to provide the resolution of 256 steps in 2ms.

To set the position of the servo, a value ranging from 0 to 255 is written into the octal latch (74LS374), and this value is then loaded into the countdown timer on the next 50Hz cycle. The timer then begins to count down from the set value until -1 (11111111b) is reached. This causes the 100kHz signal to be disabled and no further counting takes place until the next 50Hz cycle re-loads the value from the octal latch, and the counting resumes again.

The 74LS30 eight-input NAND gate connected to all the outputs of the counter serves as an OR gate here, which outputs

a high while the counter is counting. The output of this gate is the drive signal sent directly to the servo motor. I haven't found it necessary to buffer the signal to the servo, but a buffer stage can be added.

One important aspect of this design is that the position value can be written to the controller at any time, and the computer can communicate asynchronously with the circuit. This allows the computer to do other tasks while the controller handles all of the timing necessary for the servo.

A simple control program (written in Borland 3.1 C) is:

```
#include <dos.h>
#define DATA 0x378
#define CONTROL 0x37A
void servo_position(unsigned char value){
    outportb(DATA, value); //write data out to
    the parallel port data bus.
    outportb(CONTROL, 0x00); //This has the effect
    of producing a pulse on the
    outportb(CONTROL, 0x02); //linefeed control line
    of the parallel port.
    outportb(CONTROL, 0x00); //This is used to store the
    data in the octal latch.}
```

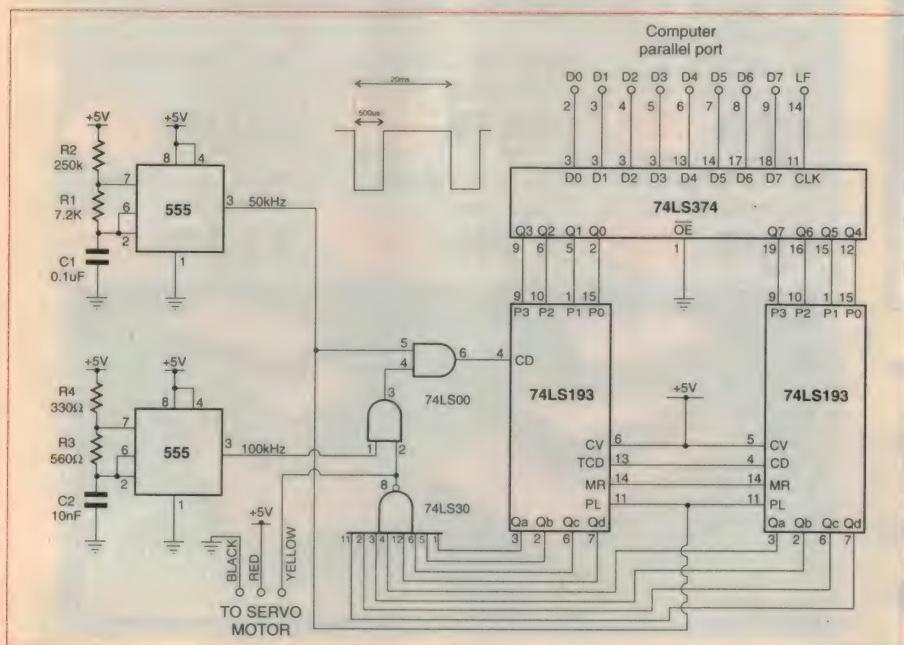
George Katz
Dee Why, NSW \$45 ♦

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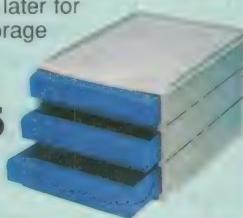
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May '97

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- Simple installation required.
- Courtesy light will stay on for an extended period after the door is closed, then fade out gradually.
- Cancels the delay extension when the car headlights are switched on.
- Can be built to suit both types of car interior lamp wiring ie, door switches to ground or door switches to +ve 12 volts.
- Extends light-on time by about 10 seconds.
- 3 wire connection to car.
- Installation can be made without cutting wires.
- Kit is supplied in shortform (PCB and components only).

Cat K-4100

\$9.90

EA Apr '97



Analogue Multimeter

Build this very useful piece of test equipment and at the same time learn all about analogue multimeters. Has 19 ranges with 20K/V and includes features such as transistor check, mirrored scale and continuity. Kit is supplied complete with all components, hardware, PCB, comprehensive instructions, deluxe multimeter case and test leads which plug into recessed sockets for added safety. Instructions and parts will also be supplied to construct the transistor test adaptor lead.

Cat K-1050

\$29.60

SILICON CHIP
Feb '97



Traffic Light Simulator

- Add realism to your model railway with this kit.
- Operates a set of lights just like a real set of street lights.
- Lights change in normal sequence; green, orange, red.
- Sequence frequency is about 5.3 seconds.
- Kit comes with PCB and components only.

Cat K 3023

\$14.95



SILICON CHIP
May '97

Speaker Protector

- Designed to mate with most stereo amplifiers, music systems or car sound systems.
- Protects speakers from damage in case of an amplifier failure.
- Turn-on delay eliminates switch-on thumps.
- Circuit and PCB designed to take power sources from 9 or 12 volts DC or from +30V to +70 volts DC (ie using the internal power source of an existing amplifier).
- Kit supplied in shortform with all components, PCB and Hi-power relay.

Cat K-5414

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SILICON CHIP
Apr '97



Dual 12V Battery Controller

- Automatically switches your auxiliary battery into the main electrical system for charging once the engine is started.
- Disengages your main battery when the engine is stopped avoiding excess drain when secondary items are being operated.
- Switches between primary and auxiliary battery automatically.
- Considerably less expensive than commercially available products.
- Supplied with components, hardware, PCB, sealed diecast box and front panel label.

Cat K 3212

\$44.50



EAI Jan '96

Train Controller

- Easy to build train controller
- Will give full, realistic control of your model trains.
- Provides full reverse to full forward speed.
- Inertia and brake switch.
- Automatic overload protection.
- Kit is supplied in shortform and includes only components, PCB and heatsink.
- Mains transformer M-2165 (9v-0-9v) required.

Cat K-3029

\$26.95



SILICON CHIP
Apr '97

\$26.95

Case and accessories shown not supplied.

Audible Car Monitoring System

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Cat K-4216

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EAI Mar '97



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Cat K-8000

\$15.9

Extra smoke alarm
PCB's available
Cat K-8001 \$5.50

SILICON CHIP
Jan '97



Availability: Our kits consist of many different parts from numerous suppliers. Whilst we have consulted closely with them and are satisfied as to their ability to supply, sometimes problems can arise in obtaining all of the parts. This means there is a slight chance that availability may be delayed. Rainchecks are available, however if you'd like to check beforehand, please don't hesitate to contact your local store.

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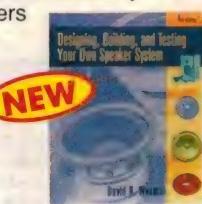
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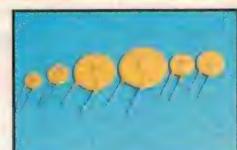


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Offers expire end of May



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STORES ACROSS AUSTRALIA AND NEW ZEALAND

Construction Project:

RMS CURRENT MONITOR

Here's a novel instrument which combines a Hall effect current transducer, a true-RMS to DC converter and a digital display module, to allow safe and accurate analysis of the current drawn by any mains operated equipment. As well as displaying the current value, the instrument also provides a fully isolated signal output to feed an oscilloscope or other instrument, to further examine the waveform and harmonic content. This makes it suitable for use in both equipment design and everyday servicing work — because many faults and problems are indicated by variations and anomalies in the mains current.

by PHIL ALLISON

In the past, a well equipped electronics workshop would include a large moving-iron ammeter with one or more ranges reading up to ten or twenty amps. It may have been wired into a GPO or used as a stand-alone unit with its own outlet. Some readers may have 'rolled their own' as I did using a standard movement and a flush socket in a plastic case.

These meters could be useful for deciding on fuse sizes, and checking just how much current an appliance or piece of equipment was 'pulling'. If combined with a 'Variac', one could determine if an overload existed before actually blowing any fuses in the mains circuits. However there were some severe limitations. For example, accuracy at low currents was abysmal due to the non-linear scale of moving iron meters. The resolution was also very limited and the reading at frequencies above 50Hz falls away, causing uncer-

tainty with many electronic loads.

The RMS Current Monitor presented here takes full advantage of modern technology to overcome all the limitations of moving-iron meters and standard clamp meters. The design provides readings from 1mA up to 20 amps and a bandwidth of 100kHz on two ranges, with an overall accuracy and linearity of 1% using a bright 3.5-digit LED display. My moving iron meter is now gathering dust!

Why monitor current?

Before describing the unit itself, a few words about its many applications might be of interest as I was unaware of its full potential myself until I built the first one...

As a service technician for professional audio equipment, a wide range of mains powered devices crosses my workbench every week, from plug pack powered devices and valve instrument

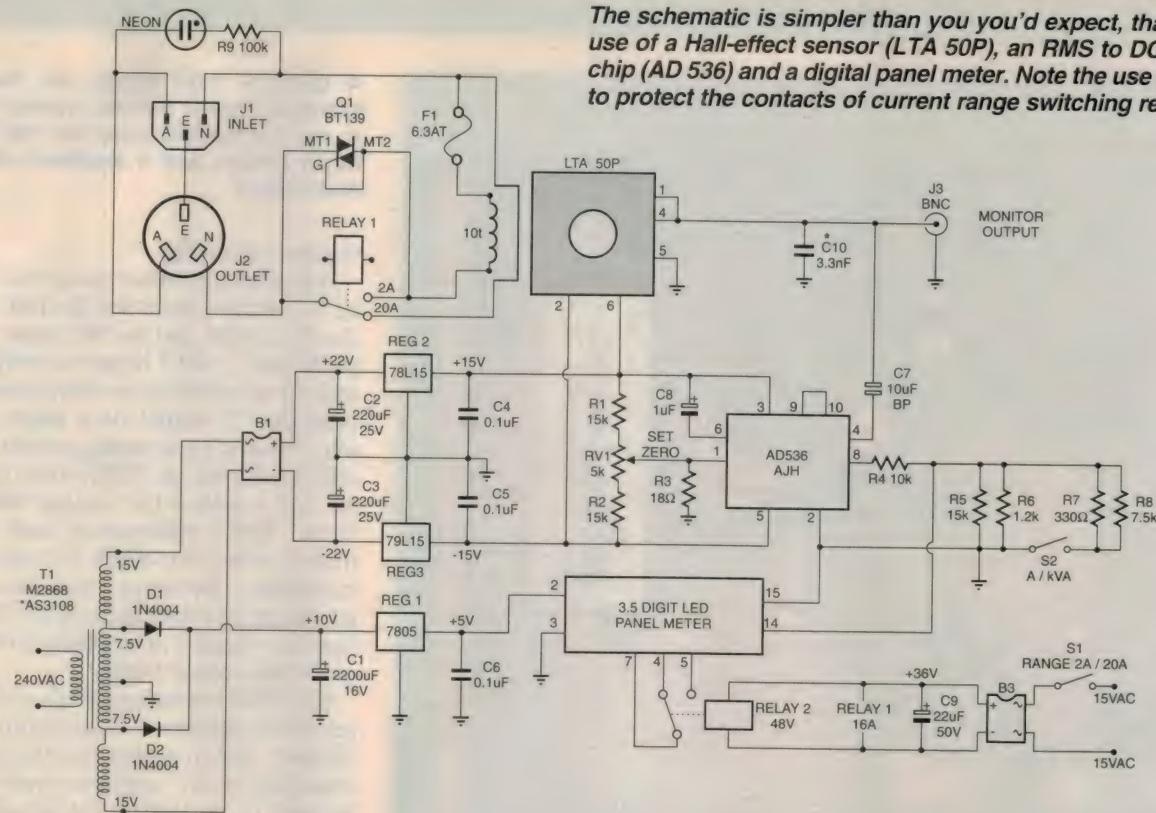
amplifiers to 2kW audio power amplifiers. The RMS Current Monitor easily handles any of the above, and having the second channel of the bench 'scope linked to the output gives me a continuous check on what is happening with equipment on the bench.

After using the monitor for a while, one acquires a 'feel' for what is normal and abnormal about the various readings and waveforms provided. Overloads and overheating units are usually obvious, and if in doubt I refer to a small 'diary' where normal on- and off-load readings for units previously seen are recorded.

The monitor can reveal all sorts of faulty and maladjusted conditions. A few examples may help explain what I mean:
1. A valve amplifier showed visible signs of heat stress, although current readings are initially normal with the chassis on the workbench. Later, after returning the unit to its cabinet, the idle



At left is the front of the author's prototype, showing the 2A/20A switch and A/kVA switch beneath the digital panel meter on the front panel. The shot above shows the rear panel, with the IEC input connector and the BNC socket for the CRO output.



The schematic is simpler than you'd expect, thanks to the use of a Hall-effect sensor (LTA 50P), an RMS to DC converter chip (AD 536) and a digital panel meter. Note the use of triac Q1, to protect the contacts of current range switching relay 1.

current reading started to creep up over 20 minutes or so — relentlessly, milliamp by milliamp. Thermal runaway? Yes, caused by a temperature sensitive, leaky electro in the bias circuit (pinpointed by applying hot air while watching the monitor).

2. After replacing the mains transformer in a Taiwanese-built unit with the identical new part, the off-load readings were high for this size transformer. Winding the Variac back to give 220V AC corrected the problem, which was due to excessive magnetising current — evident in the 'scope waveform. I advised the owner to use a 240/220 volt stepdown transformer with the unit, but he didn't and after three months the transformer burnt out again. Rewinding it with 10% more turns solved the problem.

3. A high powered MOSFET stereo amplifier required bias setting after repairs, and had no convenient test points like source resistors. The normal idle mains current reading was known and bias trims were easily set to give this reading. Each channel's bias was alternately turned fully off and then back to the previous setting, to check that an equal increase in reading occurred in each channel. The bias setting was then re-checked when each output stage is hot, without needing access inside to investigate thermal problems.

4. A high power triac light dimmer needed testing and calibration of the 0 to 10 volt remote control inputs. A 2kW room heater was connected as a load and the BNC output waveform provided a perfect replica of the chopped voltage at the output of the dimmer. This is both convenient and so much safer than connecting a 10:1 'scope probe to the back of a mains plug with the cover off!

Designing it

On the grounds of safety, a non-contact method of measuring the mains current is always preferred. Either a current transformer as used by clamp meters, or the modern Hall effect transducer can provide the desired safety by sensing the magnetic field around a wire (which is in proportion to the current flowing through it). Hall effect units have the advantage of flat response down to DC and up to 100kHz (for the particular unit used here), as well as linear conversion of current to voltage at the output.

For a description of the Hall effect itself and a typical sensor, see the article by Graham Cattley, 'High Isolation Current Adapter', in the November 1996 issue of *EA*.

The LEM LTA 50P transducer used here is a little smaller than a matchbox, with a 10mm hole in the middle for cur-

SPECIFICATIONS

BNC output	DC to 100kHz
Bandwidth	100mV and 1V per amp
Sensitivity	100 ohms
Source resistance	+/-10 volts
Maximum output	+/-10mV typical
Residual offset	Display
Type	3.5 digit, 12.7mm LED
Rectifier type	True-RMS from 10Hz to 100kHz
Accuracy	1% of reading +/-1digit
Crest Factor	5 at 1% error for 100Hz and above
Ranges	2A and 20A FSD
Resolution	1mA and 10mA (1 digit)
kVA switch	scales reading by 0.24 (for 240V)
Inlet-Outlet circuit	20A range 10A continuous, 20A short term
Range switch	2A range 6.3A continuous, fuse protected No interruption to supply, relay operated
Monitor supply	200 to 260 volts AC, 6.5VA



A general view inside the author's monitor. Power for the monitor itself is not via the IEC input for the monitored circuit, but a separate captive mains lead.

was not important.

A precision rectifier circuit was needed to interface between the Hall transducer's output and the DC input of the panel meter, and I began to design one when it occurred to me that a true-RMS converter IC would do a much better job. These ICs use analog circuit methods to compute the RMS value of a signal and output a DC voltage with this value. RMS multimeters and clamp meters using true-RMS ICs are commonplace nowadays, and have the advantage of allowing accurate VA and heat loss figures to be derived for various mains related loads.

The LEM transducer needs +/-15 volt regulated supplies to meet its full specification, and to match this the AD536 true-RMS to DC converter was chosen because of its large input signal range and wide bandwidth. Other similar converter ICs from Analog Devices are more suited to battery operation.

The two ranges for the monitor were created by placing an extra 10-turn winding around the transducer and selecting either it or the one-turn loop with a SPDT power relay. A second relay, with gold clad contacts and operated in parallel, selects the decimal point options on the display. (A DPDT switch might have been used, however one hefty enough to handle high mains currents would not suit small signals nor provide sufficient separation of the two circuits.)

When the first unit had been con-

rent carrying wires to pass through. Its operation depends on a feedback coil and drive amplifier within the transducer, which act to null out the magnetic field produced by current flowing through the hole. The Hall element detects this null condition, while the necessary current to drive the feedback coil is passed through an internal 100 ohm resistor to generate the output signal. This method may sound convoluted, but has the simultaneous advantages of high sensitivity, linearity and large current handling.

The transducer is rated at 50A RMS sinewave on one turn, but samples tested all delivered a peak output of 10 volts — which at 100mV per amp equates to a 100A current maximum. This may seem a very high level, but is in fact a typical value for switch-on transients with large transformers. It is often necessary to be able to detect such surges, when selecting fuses and switches for the mains.

Once the particular Hall effect transducer had been chosen, along with LED

panel meter there was really not too much designing to do. I had decided against an LCD display on grounds of poor readability, and since mains power would always be available the minuscule power consumption of a LED display

Use this closeup as a guide when you're winding the two primaries on the Hall sensor. We recommend that you fit heat shrink sleeves to the active and neutral lugs of the IEC connector in your unit, to prevent accidental shocks when the cover is off.

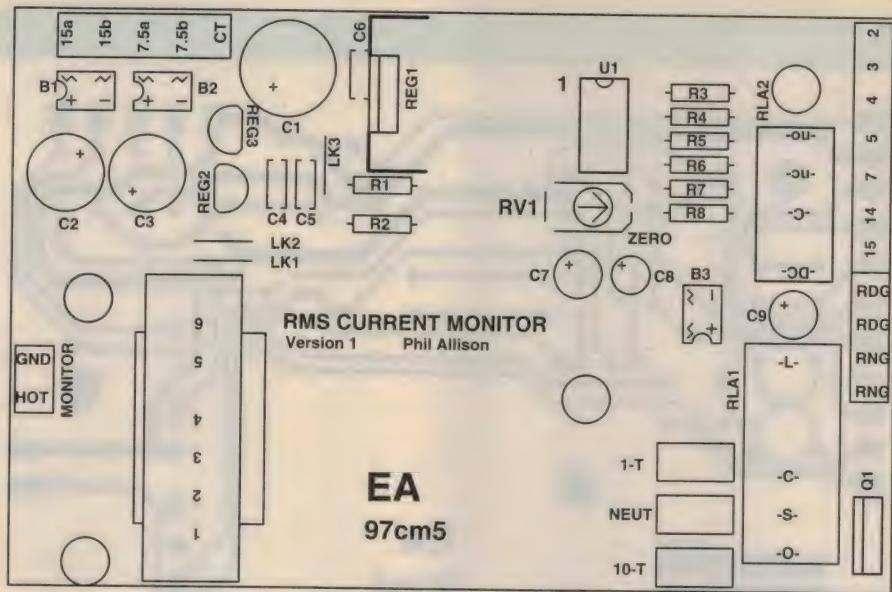


This overlay diagram shows where everything goes on the PCB. For further guidance in wiring up your monitor, please refer to the internal photos.

structed and put into service, it soon became obvious that the 16A relay contacts were not going to last long. Bright blue flashes occurred when changing range, especially with large power transformers in use. This was due to spikes when the relay contacts opened and surges when they closed. On one occasion the panel meter IC failed as the range was being changed. Clearly a cure for the sparking had to be found!

Eventually it occurred to me that since the voltage difference between the two fixed relay contacts was only millivolts, even at full load, possibly a pair of back-to-back diodes wired across the relay would limit interruptions to the supply to no more than one diode voltage drop and stop the arcing. These diodes would only need to conduct current during the few milliseconds it takes a moving contact to make the changeover. The idea was soon trialled and worked like a charm; all signs of arcing were gone since now the range changing occurred without breaking the mains supply.

Later a 16A triac was fitted with its gate



tied to MT2, as a single component alternative to using two large diodes. Connecting the triac from the moving contact to the 2A range contact on the relay is necessary because otherwise the triac would have to carry the full load current if the 6.3A fuse failed. Without a heatsink it would very quickly overheat!

I had originally hoped that the monitor could be DC coupled, however test-

ing revealed that a small and variable residual magnetisation occurred inside the Hall effect transducer each time a heavy load was disconnected. This created a variable offset at the unit's output that depended on previous history, and would have spoiled the monitor's otherwise excellent accuracy at low currents.

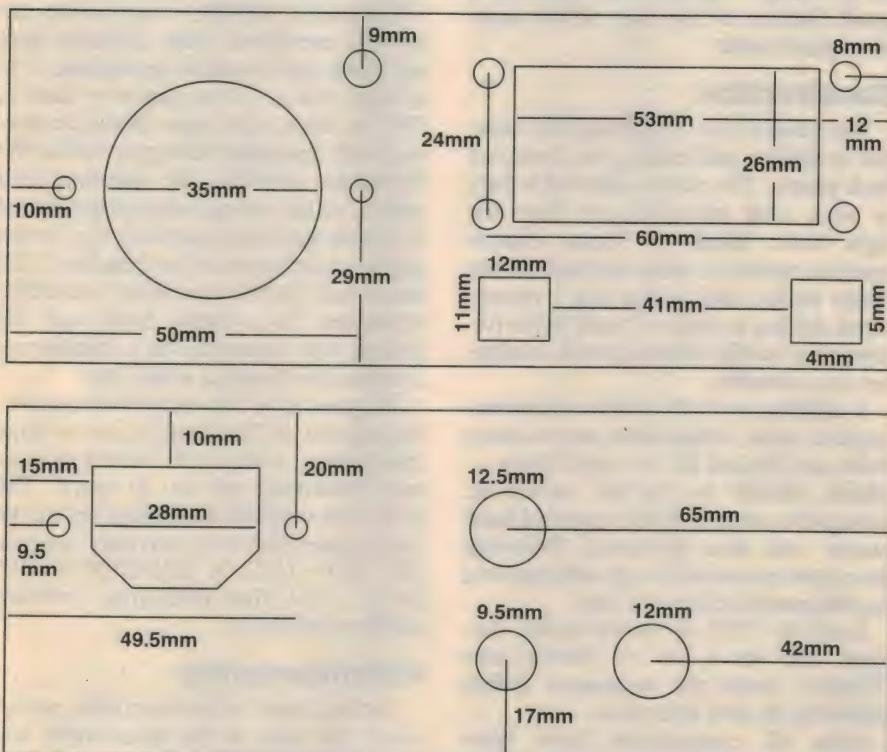
A 10μF bipolar capacitor at the input of the AD536 IC eliminates this offset. The small and fixed offset at the output of the IC is removed by adjusting VR1, and the overall calibration of the monitor is done by adjusting the trimpot on the LED panel meter PCB. No separate calibration is needed for the two ranges since the 10:1 ratio is determined by the windings and is exact.

Circuit details

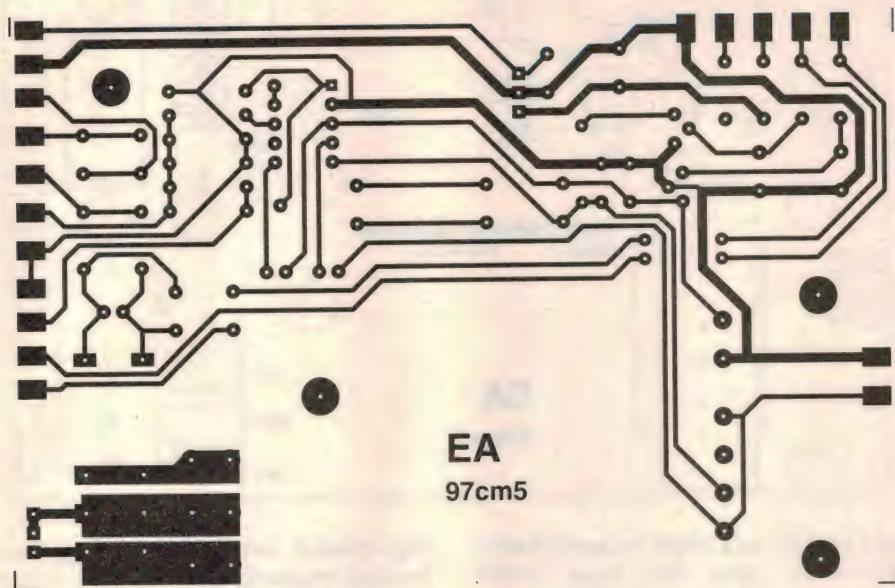
The monitor consists of a mains powered metering and display system and an electrically isolated measuring circuit, shown in the top left of the schematic. Most of the components, including the Hall effect transducer are mounted on the PCB; the main exception is the LED panel meter.

The power supply uses a multi-tapped transformer with 30V and 15V secondaries having a common centre-tap. The two 7.5V taps are full-wave rectified and feed a 7805 regulator which supplies the panel meter with about 175mA. The two 15V taps feed a bridge rectifier and a pair of 78L15 and 79L15 regulators to supply the transducer and converter IC. A second bridge rectifier connected via a push-on/push-off switch supplies the two relays. Switching the AC feed prolongs the life of the contacts in the switch.

The Hall effect transducer has a specified output of 100mV per amp per turn, so that with 20A in a one-turn loop it outputs



These diagrams show the location and size of the holes in the front and rear panels of the current monitor case, to accept the various controls and connectors. At top is the front panel, with the rear panel shown below. Note, however, that the rear panel is viewed from the front of the case.



Here is the PCB pattern for the current monitor, as usual reproduced actual size for those who like to etch their own board.

tom of the case with 4mm nuts and bolts. Some plastic may have to be trimmed to make it a good fit. The back and front panels can now be assembled with all the connectors, switches and the panel meter.

Next take a 700mm length of 1mm diameter enamelled wire and starting in the middle and winding each half in turn, feed 9.5 turns around the transducer (see photo). Trim off any excess and bare the enamel at each end ready for soldering. Make up three short leads with 10A-rated wire, ending in 6.35mm female spade connectors with insulators for the three PCB male spade terminals.

Before installing the PCB in the bottom half of the case, attach suitable multi-coloured flexible leads to all the solder pads excepting the ones used by the transformer. Trim these to length and prepare the ends. Install the PCB by first soldering the leads from the transformer to the appropriate pads, then fit the board and complete the multi-coloured wiring.

The mains inlet and outlet wiring can now be completed. Keep all leads short and direct and tie where appropriate. Use at least 10A or 1.0 sq.mm wire rated at 70°C or more. Any joins should be covered with heatshrink tubing as well as the fuseholder contacts. The one-turn loop returns via the wiring loom and so appears to be only half a turn; similarly the 10-turn appears as 9.5 turns on the transducer. The mains lead for the transformer should be terminated in a screw block and the ground wire connected to a transformer mounting bolt using a solder lug.

The prototype was subjected to a prolonged test at 20A from a low voltage transformer, without the wiring or contacts becoming too hot to touch. The 6.3A fuse was chosen to blow before the 1mm enamelled wire becomes too hot; DO NOT USE A LARGER FUSE! (Note: a 2A fuse here gives constant nuisance failures.)

Commissioning

Double check all connections, particularly the ones to the transformer and the panel meter. At switch-on, the display should light with all digits showing and quickly settle to a low reading. All supply voltages should be compared with those shown on the circuit, starting with the +5 volt output.

2.00 volts DC or RMS AC. Similarly with a 10-turn loop carrying 2A the output will also be 2.00 volts. The transducer output is fed directly to the BNC connector to drive a 'scope, computer etc. The 3.3nF cap suppresses any RF noise at this output, which by the way has an internal resistance of 100 ohms.

Following the transducer the AD536 does the RMS computation and outputs a DC level equal to the true-RMS value of the input signal. C8 sets the time constant for the rectifier part of the IC (see note 1). There is in effect no change in the level here except that any DC component is eliminated by the 10μF capacitor.

The resistor network on the output of the AD536 (pin 8) firstly scales the voltage by a factor of 0.1 to match the 200mV sensitivity of the panel meter, and then by a further factor of 0.24 to derive a kVA value from the reading (provided the mains is assumed to be at 240V). The kVA pushbutton selects the 0.24 scale factor only when held in, to avoid incorrect readings on the display. It also makes it possible to bring back a reading on the display that has gone overrange — although at 24% of its actual value. This feature should be used only briefly and with caution, otherwise the 6.3A fuse may blow.

Finally the 3.5-digit LED panel meter shows the RMS value of the current being monitored, and its display is highly readable even from several metres away and in low light conditions. The recommended panel meter from DSE (Q-2210) is self contained and employs the Intersil 7107 DVM IC mounted in a

40-pin socket. An on-board inverter creates a negative supply for the IC and also there is a band gap reference diode and provision for calibration. The unit is supplied with a circuit, can be fully disassembled and is repairable. The 7107 IC is widely available and sells for a small fraction of the cost of the complete panel meter.

Construction

The hardest part of building the monitor is drilling and cutting the front and back panels. The plastic material is easy to work with provided you have the right tools. Ideally a 35mm chassis punch is needed to make the hole for the mains outlet, and failing this I recommend drilling a circle of small holes followed by careful rounding with sandpaper on a mandrel.

A nibbling tool will cut the various rectangular holes, while some not-too-sharp drills can be used for the round holes — which should be drilled undersize, enlarged to exact size with a tapered hand reamer and then de-burred. Drawings have been provided to help with marking out the panels before you start.

Load the PCB as shown in the diagram and put a line of neutral cure 'Silastic' under the transducer before soldering its pins into place.

After all components have been mounted and their values and positions double checked, the solder side can be de-fluxed, dried and spray coated with PCB lacquer after masking the various solder pads with tape.

Mount the mains transformer to the bot-

When the range switch is pressed, both the relays should click and the decimal point should move one position to the left. If all is OK, then adjust the trimpot on the PCB until the display shows all zeros and the negative sign just goes out. It should be possible to set the reading a few millivolts positive or negative, while all normal readings on the monitor will be positive.

If an audio generator is to hand, then feed it into the BNC socket and a reading should appear on the display. Try varying the frequency over the range from 20Hz to 100kHz, to check the response of the converter IC. If all is well so far, then fit an IEC lead to the inlet socket and connect an appliance with a known load to the outlet — like a lamp. Hopefully the appropriate reading should appear in amps on both ranges. If the reading on the 2A range is 10% high or low, you have miscounted the turns!

Calibration

The trimpot on the LED panel meter calibrates the instrument on both ranges, so either can be used for this purpose. There are two ways of passing a known current through the monitor:

- Measure with a digital meter the voltage across a known load resistance connected to the monitor outlet, and compute the current value.
- Measure with a digital multimeter set to its amps range the current in series with a load connected to the monitor.

For safety the above tests are best done with a low voltage from the secondary of a mains transformer, into a power resistor.

The accuracy will depend of course on the calibration of your digital multimeter. Most will read AC voltages within +/-1%.

Using the Monitor

The monitor is suitable for use with any mains powered equipment, and especially those which incorporate a mains transformer and rectifier circuitry. The waveform output will indicate whether the load is transformer, switch-mode or resistive and some detailed interpretation is required.

Fig.1 shows a typical monitor waveform for a piece of electronic equipment, incorporating a transformer and DC power supply. The sharp peaks 'c' indicate the charging pulses in the filter capacitors, while the broader peaks 'm' are due to the transformer's magnetising current. The former are in phase with the mains voltage maxima, while the latter coincide with mains zero crossings 5ms later. Where a toroidal transformer is used the magnetising peaks

are usually much smaller, while a mains voltage switchmode supply shows only the sharp charging peaks.

If the supply is faulty or overloaded this will be evident by changes in the waveform. A few examples:

PARTS LIST

Resistors

All 1/4-watt 1% metal film unless specified:

R1,2,5	15k
R3	18 ohms
R4	10k
R6	1.2k
R7	330 ohm
R8	7.5k
R9	100k, 1 watt 5%
RV1	5k horizontal trimpot

Capacitors

C1	2200uF 16VW PC electro
C2,3	2200uF 25VW PC electro
C4,5,6	0.1uF 63VW MKT
C7	10uF 50VW bipolar electro
C8	1uF 50VW PC electro
C9	22uF 50VW PC electro
C10	3.3nF 100VW polyester

Semiconductors

U1	AD536 AJH true-RMS converter
REG1	7805 5V regulator
REG2	78L15 +15V regulator
REG3	79L15 -15V regulator
Q1	BT139-400 or BTB16-400 triac
B1,3	1A DIP bridge
D1,2	1N4004 diode

Assemblies

PCB	78mm x 118mm, coded 97cm5
LTA50P/SP1	Hall effect transducer (Farnell #107-803)
Q2210	LED panel meter (DSE) or similar
T1	M2860 15-7.5-0-7.5-15V, 500mA transformer
RLA1	SPDT 16A/48V relay (Farnell #431-333 or equiv.)
RLA22	DPDT 1A/48V relay (Farnell #179-863 or equiv.)

Hardware

Case	155 x 65 x 160mm plastic (DSE H-2508 or similar)
J1	3-pin IEC male mains inlet, 10A rated
J2	Clipsal 415 series flush mount 3-pin socket
J3	Panel mount BNC socket
S1	SPST push on/off switch (DSE P-7540 or similar)
S2	SPST push on switch (DSE P-7550 or similar)
F1	20 x 5mm, 6.3A HRC delay fuse (Farnell #533-798) (Holder M205, DSE P-7914 or similar)
Neon	DSE P-8112 bezel or similar

Miscellaneous

Mains lead and plug; cable gland; two way mains screw block; TO-220 mini-heatsink; 700mm x 1mm enamelled wire; 3 x 6.35mm quick connect PCB male and 3 x cable females; 10A rated (1 sq.mm) PVC coated wire; 150mm of 4mm heatshrink tubing; 50mm of 20mm heatshrink tubing; two off 4mm x 25mm bolts; 2 off 4mm x 12mm bolts, 4 x 4mm nuts and shakeproof washers; 6 x 4mm plain washers; 2 x 6mm standoffs; 3 off 3mm x 12mm bolts; 3 x 3mm nuts and shakeproofs, 6 off 3mm x 100mm cable ties.

- Missing charging peaks — blown internal fuses.
- Missing positive or negative peaks — rectifier faulty.
- Uneven peaks — filter capacitor high resistance.
- Magnetising peaks larger than current peaks — transformer saturating; check voltage selector and VA ratings.
- Large sinusoidal waveform — primary or secondary turns shorted.
- Magnetising peaks uneven — DC component in mains or load.
- Test frequency visible in mains current — open filter cap.

True RMS figures

The RMS reading on the Monitor's digital display is a good guide for selecting mains fuses. A fuse value about 50% greater than the maximum reading obtained under operating conditions should be adequate to prevent nuisance failures. Of course, transformer loads need a slo-blo or delay fuse to prevent failures at the moment of switch-on.

The heat dissipated in a mains transformer is easily calculated using the reading on the monitor. Just measure the DC resistance of the transformer primary and multiply by the square of the RMS current draw; then double this figure since the heat developed in the primary and secondary are nearly equal when under load.

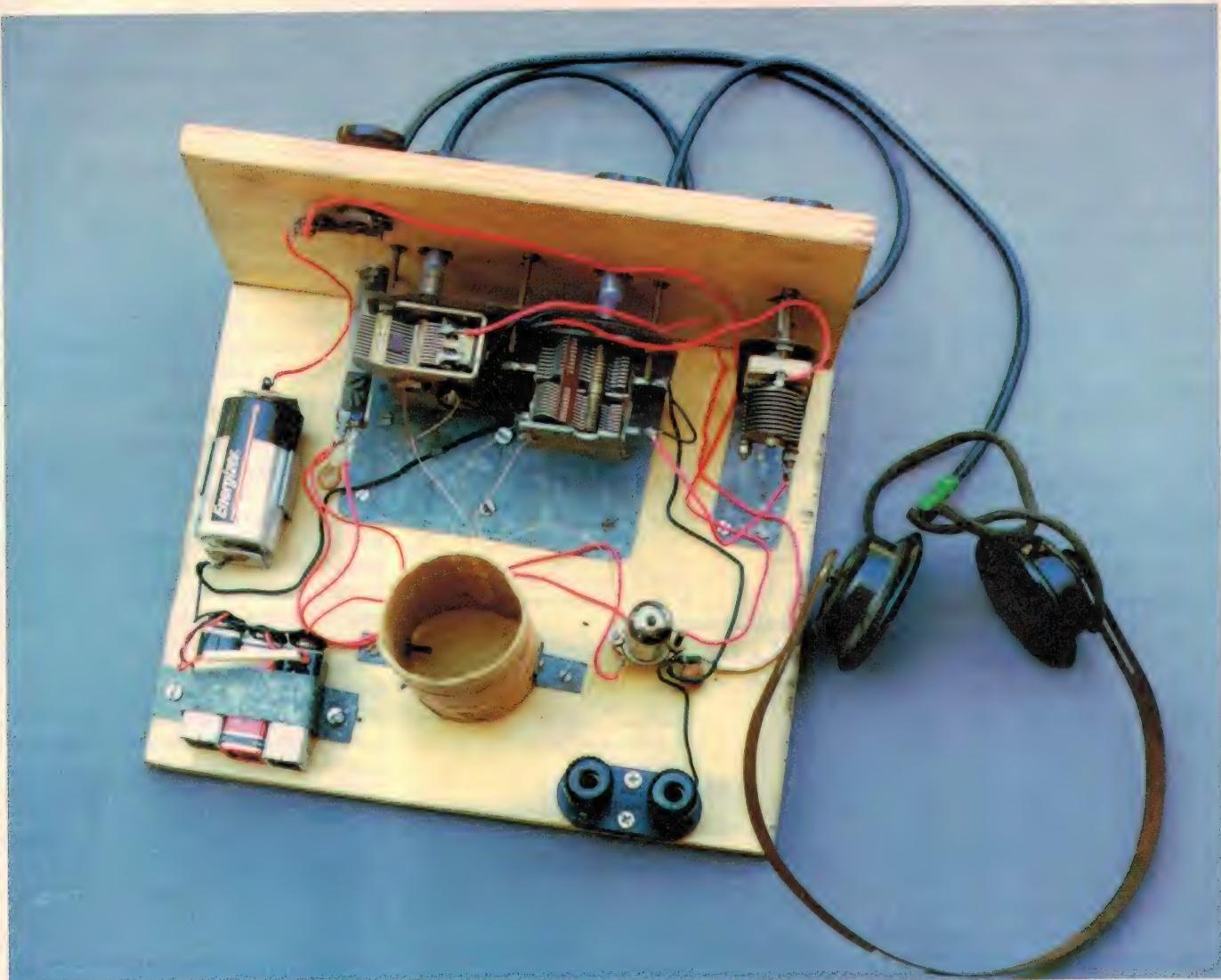
Pressing the kVA button will provide accurate readings if the mains supply is close to 240 volts. By definition, VA is the product of the RMS applied voltage and RMS current drawn by a load.

To RMS or not RMS?

In some cases it is not appropriate to use the RMS value of the AC current, for example semiconductors like diodes and triacs have a relatively constant voltage drop over a wide current range. Because of this, their heat dissipation is proportional to the average rectified value of the current. Battery chargers are another example where this value is needed.

Just in case there is any confusion, where the current flowing is steady DC then all the other values converge to the DC value.

To obtain the average rectified value for a symmetrical current waveform, just connect a standard multimeter to the monitor's BNC outlet and note the AC voltage. Find the current, taking into account the range in use, and then multiply the reading by 0.90 to find the average rectified value. This will remove the average to RMS correction factor (1.11) used in non true-RMS meters. ♦



Special 'nostalgia' project:

BUILD AN OLD TIME ONE-VALVE RADIO - 1

There's a lot of interest nowadays in building simple valve-based radio sets, of the type that were popular from the 1920s right up until the 1960s. Here's the first of two articles which give all the information you'll need to construct an authentic one-valver — starting with a basic 'grid-leak' set and progressing to a regenerative circuit with surprisingly good performance. Enough information is given to allow you to use almost any old valve or other components to hand.

by PETER LAUGHTON

Cleaning out my radio 'shack' (read mess) the other day, I came across a number of radio receivers that I constructed years ago based on valves, and remembered how much fun I'd

had, and how much I'd learned. This, along with several recent Letters to the Editor asking for more vintage radio projects, resulted in me talking to Jim Rowe, and the result of that dis-

cussion is the following project.

The circuits described can be built using almost any combination of components, even from junked valve TV sets. But for convenience and safety,

they will be described using a 1.4 volt battery valve that is still available: the 1T4. The filament of this valve is supplied from a single 1.5V alkaline battery, whilst the 'high tension' comes from two or three 216-type 9V batteries connected in series. The parts to construct the radio are also available from the Vintage Wireless Radio Company in Sydney if your junk box doesn't have enough 'bits and pieces' in it. (See end of article for prices etc).

Understanding feedback

Before we start, a few words about *feedback*. To many people this is usually associated with a rude, loud noise from a PA amp at a concert, etc. But technically the term means something much more useful, which can exist in two forms: positive and negative.

Basically, feedback is achieved by feeding back energy from the output of an amplifier to its input. If the signal fed back is *in phase* or in step with the original signal, then it adds to it and this is called *positive feedback*. This type of feedback tends to exaggerate or enhance any frequency selectivity; hence the effect with PA amps, where the sound begins to 'ring' at a particular frequency before a condition is reached where the whole set-up becomes unstable — i.e., begins oscillating.

The effect of positive feedback is to increase the signal available at the output over what was there before — i.e., the effective gain increases, as well as the selectivity. If there's too much positive feedback, the amplifier will become an oscillator. Another word for positive feedback is *regeneration*.

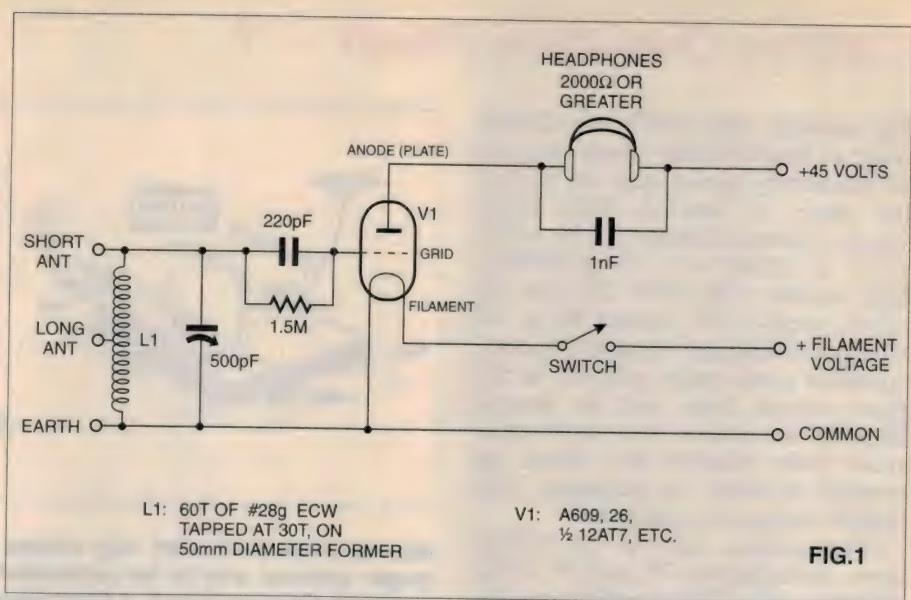


FIG.1

A basic 'leaky grid' receiver circuit, using either a triode valve or a multi-grid valve connected as a triode. This type of set uses the valve's grid and cathode as a detector diode, and then the valve as a whole to amplify the resulting audio.

Conversely, if the feedback is *out of phase* or out of step with the original input signal, so that it subtracts from it, then it is said to be *negative feedback*. In this case the total amplification is reduced.

Commonly called *degeneration*, this type of feedback tends to smooth out any frequency selectivity, and also reduce the amount of distortion produced by an amplifier — as the output distortion is present in the signal fed back to the input. The amplified feedback distortion is in opposition to the output distortion (as it's out of phase) and thus tends to cancel it out.

Negative feedback also tends to compensate for changing characteristics of

components in a circuit as well as the effects of temperature, especially with solid state components. Negative feedback is commonly found in audio amplifiers, and can be applied to several stages of an amplifier at the same time.

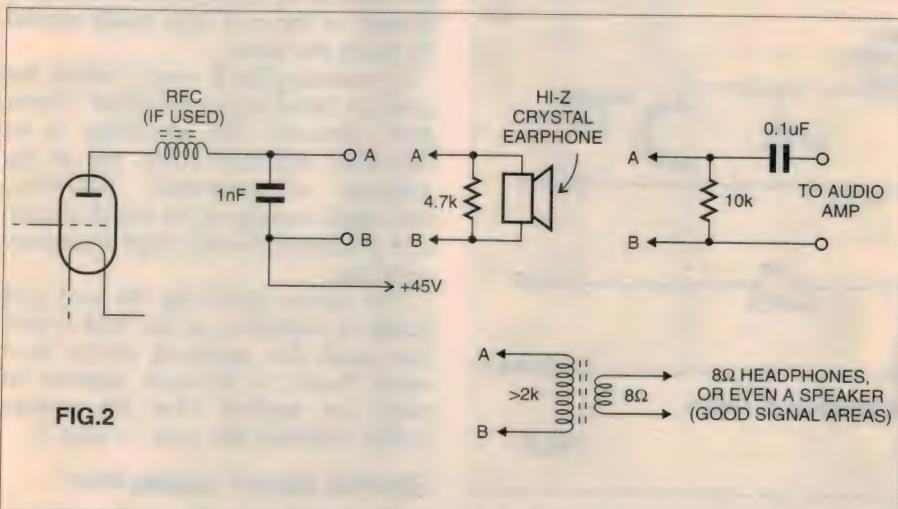
Grid detectors

The basic circuit for a grid or cumulative type of detector is shown in Fig.1. As can be seen, apart from a crystal set, nothing could be simpler.

Interestingly, there is no solid state equivalent for the 'grid leak' type of detector shown here. Even the field effect transistor, whose characteristics approach that of valves, doesn't work as well as a valve does. Therefore this circuit arrangement is unique to valve technology.

In this type of detector, the grid corresponds to the plate of a diode, which works together with the valve's filament or cathode to detect the incoming RF signals — fed to it from the tuned circuit formed by L1 and the 500pF capacitor. As a result of this diode action the rectified RF produces a varying DC voltage across the 1.5M 'grid leak' load resistor, with the 220pF capacitor acting as a low impedance to the RF signals. The varying DC voltage then causes the grid to vary the electron flow to the plate, giving some audio amplification at the same time. Note that at this stage we haven't applied any regeneration or feedback.

Typical component values are given and almost any triode valve, or any valve wired as a triode, can be used.



Three different alternative ways to use the output from the basic receiver of Fig.1 — or those of Fig.3, 5 or 6 — if you don't have a pair of high-impedance headphones.

Oldtime One-Valve Radio — 1

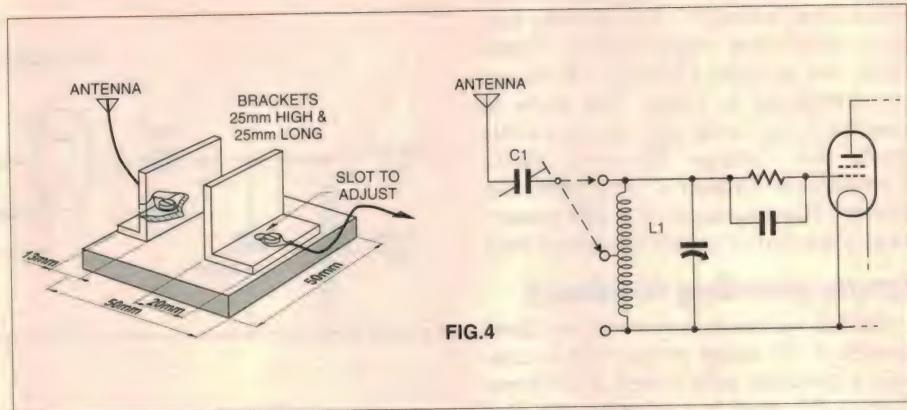
For example, the 12AT7 and 12AU7 range of double-triode valves, etc., are all satisfactory (using only one half of the valve, of course). With these valves, filament voltage can be either 12.6V at 150mA or 6.3V at 300mA. High tension with these TV type of valves needs to be around 60 to 90 volts for satisfactory operation. Battery operation is not really practical as the plate current drain will be around 20mA or so, and the 10 or so 9V transistor radio batteries that would be required to obtain the necessary high tension voltage are expensive!

Other triodes, such as the battery types, including the 2V and 6V series of battery valves like the A609 can also be used. Pin connections for some typical valves that can be used in this circuit are at the end of this project (Fig.9). Just make sure that you use the correct filament voltages and currents.

A 6U7 pentode from the octal era can also be used. Just connect the screen grid to the anode to convert it into a triode and supply the filament with its 6.3V at 300mA.

The valve used in the prototype was a 1T4 miniature seven-pin battery pentode, wired as a triode, (grid 2 on pin 3 connected to the anode). The output is to a crystal earpiece, or high impedance headphones, or some low impedance stereo type headphones (using a matching transformer), or even to an external amplifier using any of the circuit arrangements shown in Fig.2.

Fig.3 gives the same circuit in



How to make your own very simple adjustable series capacitor, to allow a longer antenna wire to be connected to the receiver's tuning circuit without loading it down too much. A fixed mica or ceramic capacitor of about 200pF can be used instead, if you wish.

which a multi-element valve, such as the 1T4 pentode, is now used as a pentode rather than wired as a triode. The sensitivity of this type of detector is considerably increased by using a pentode valve. As before no feedback or regeneration is applied as yet. Filament voltage is still 1.5V DC, whilst 18 to 27 volts DC (two or three 9V radio batteries) are satisfactory for the high tension (HT) requirements. Battery life will be several months of intermittent use, with the filament drawing 50mA at 1.5V and the anode current about 3mA at 27V.

Fig.3 also shows how a radio frequency choke (RFC) can be used, giving more stable operation of the circuit especially when used on short wave.

The grid leak type of detector is sensitive, but it 'loads' the tuned circuit, resulting in relatively poor selectivity (the ability to resolve different signals close to each other). The linearity is poor, as is the signal handling capacity. This means that it is easily overloaded by a strong signal, which can completely drown out a weaker signal adjacent to it. Note also that if the plate voltage is made too high, the no-signal current can increase beyond the ratings of the RFC, headphones, or transformer and they can be permanently damaged.

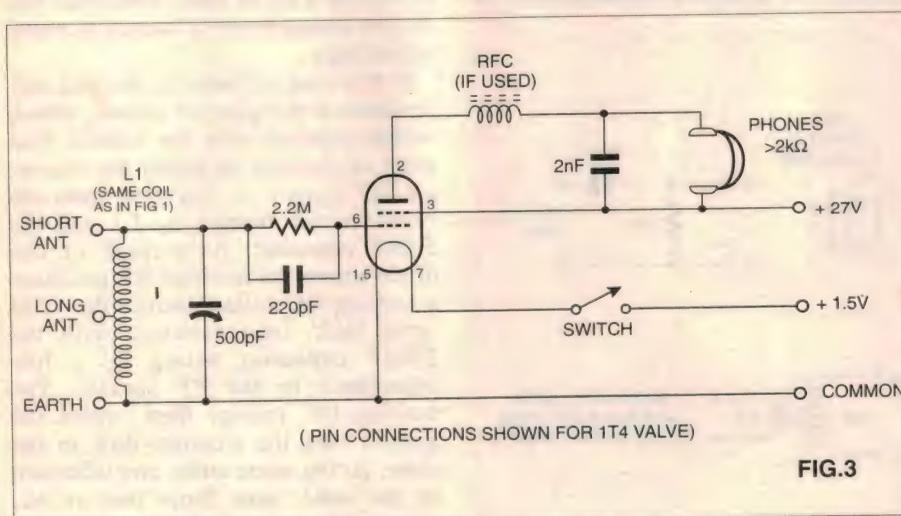
Try experimenting with lower values for the grid leak resistor (down to 100k) and lower values for the associated condenser (to say 100pF). Also try connecting the grid leak resistor to the cathode or earth side of the valve instead of the coil. The result should be much the same.

By reducing the R and C values, the detector turns into a so-called 'power grid' detector. The advantage is an increased overload point, but at the expense of increased distortion, increased loading of the tuned circuit, and a decreased audio high frequency response.

The values given for the coil will result in operation on the AM broadcast band. For operation on the short wave bands, a different number of turns are needed. (See the section called 'winding the coils' in part 2).

Series aerial capacitor

A series-pass capacitor is needed to prevent the aerial from loading the tuned circuit too much. A small tuning capacitor scrounged from a junked



How to use a multi-grid valve like the 1T4 as a leaky-grid detector. Although not shown, there is a third grid in this pentode valve, connected internally to the filament (pins 1 and 5). The optional RF choke can be used as shown, to improve performance and stability.

The sensitivity and selectivity (tuning sharpness) of the leaky-grid receiver can be improved dramatically by adding some positive feedback or 'regeneration', by means of a second coil L2 coupled magnetically to the tuning coil. The 200pF variable capacitor is used to adjust the feedback so that it isn't enough to cause oscillation or 'howling'.

AM/FM radio is perfect, if you use the FM tuning section (this is the one with the least number of plates). Alternatively, try a standard broadcast tuning capacitor. The adjustment isn't too critical and, once set for your particular length of aerial and location, shouldn't need altering.

For those not wanting to go to these lengths, any small mica or ceramic capacitor of value to 200pF or so will work instead. The object of it is to reduce the aerial coupling a bit, which reduces the loading on the tuned circuit and increases selectivity — although at the expense of volume. Fig.4 shows how to construct a suitable small value capacitor from scrap metal, and how it's connected.

Regenerative detector

Now let's have a look at making the basic grid leak detector a bit more efficient. To do this we add a controlled amount of positive feedback, in the form of regeneration. This forms the basis of the regenerative detector, which was in use almost since radio began right up until after World War 2. The results from such simple cir-

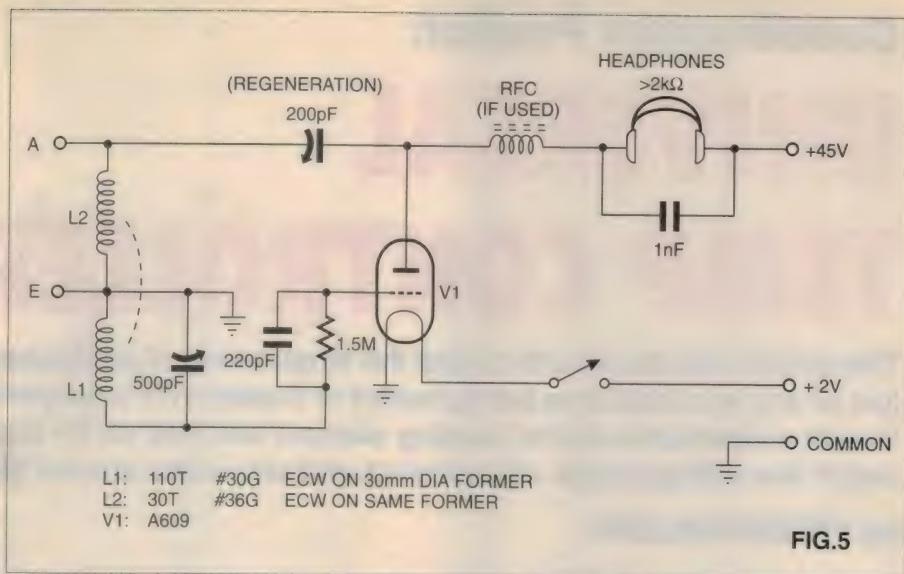


FIG.5

cuits can be amazing, with after-dark broadcast band reception of England and the Continent, and daylight reception of interstate broadcast radio stations not uncommon during radio's early years.

Note that this type of detector is very different from the 'reflex' type, as reflex detectors use the valve twice — first as an RF amplifier before detection, and then as an audio amplifier after detection.

Also note that the regenerative detector about to be described is different from a *superegenerative* detector, which is actually a regenerative detector adjusted to oscillate, and then 'quenched' at a high frequency of 20kHz or so to enable it to be operated as an extremely sensitive detector

— although one that tends to cause interference to other receivers.

If there is enough interest, a simple, mains powered, regenerative all-band receiver will be described in a future article. The simple receiver about to be described can also be modified into a reflex receiver that can operate a loudspeaker on local stations, still using the one valve.

In Fig.5, we have the basic circuit of a regenerative detector. It is shown based on an A609 triode valve, although a 1T4 pentode wired as a triode by connecting grid number 2 to the plate will also work satisfactorily. The circuit is almost the same as the previous one for the grid leak detector, but with regeneration added via feedback coupling coil L2 and its adjustable 200pF series capacitor from the valve plate.

In this circuit, the regeneration increases the effective Q (quality) of the tuned circuit. This occurs because maximum regeneration occurs only at the frequency to which it is tuned. The values for components are almost the same as for the grid leak detector. Obviously, the amount of regeneration must be able to be controlled somehow and is usually held to a point just before the valve goes into oscillation. This point also varies with frequency, so the tuning of a regenerative detector is a two-handed affair!

Fig.6 gives the circuit of a regenerative receiver using a pentode battery valve, with separate windings for the aerial, tuned and feedback coils.

In the second of these articles, we'll look at winding the coils and actually building the practical regenerative one-valve receiver shown in the photo.

(To be continued.) ♦

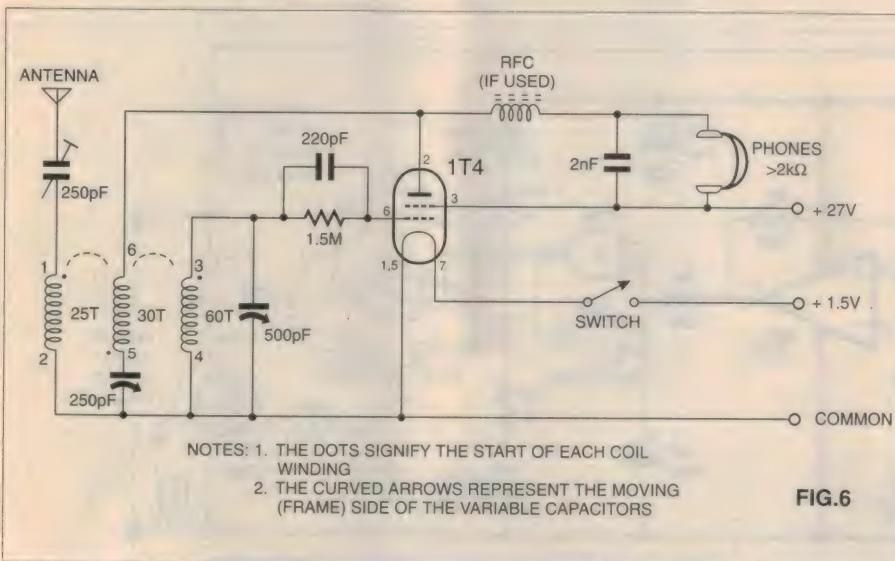


FIG.6

The circuit of a complete one-valve regenerative receiver, using a 1T4 pentode. Although still very simple, this type of set is capable of surprisingly good performance. Full construction details will be given in the author's next article.

Construction Project:

UNIVERSAL TEMP CONTROLLER

This project can be used to control the temperature of an incubator, plant germinating box, aquarium or any enclosed area being heated or cooled over a temperature range of 0°C to over 100°C. It uses a thermistor as the sensing element and has an on-board 50V/10A MOSFET to directly switch low-voltage loads. It's compact and only costs around \$20.

by PETER PHILLIPS

We've had a number of requests over the years for a simple incubator-type temperature controller. This project is from Oatley Electronics and consists of a thermistor that connects to a printed circuit board measuring 75 x 35mm. The board has two LEDs to show the status of an onboard MOSFET that can switch up to 500W of power to a heater element or other device.

By using a relay driven by the MOSFET, you could use the controller to switch any type of load, including heating or cooling equipment. Or it could be used as an over-temperature alarm. For example, the thermistor could be mounted near heat sensitive electronics, or attached to a battery while it's being charged, with an audible alarm switched by the MOSFET. A simple piezo alarm would suit, perhaps mounted directly on the controller PCB.

But the project's main purpose is for simple temperature control applications, such as an incubator, an aquarium or the like. For these tasks, the heater can probably be switched directly by the MOSFET, so all you'll need is this project, a suitable heating element and a power supply.

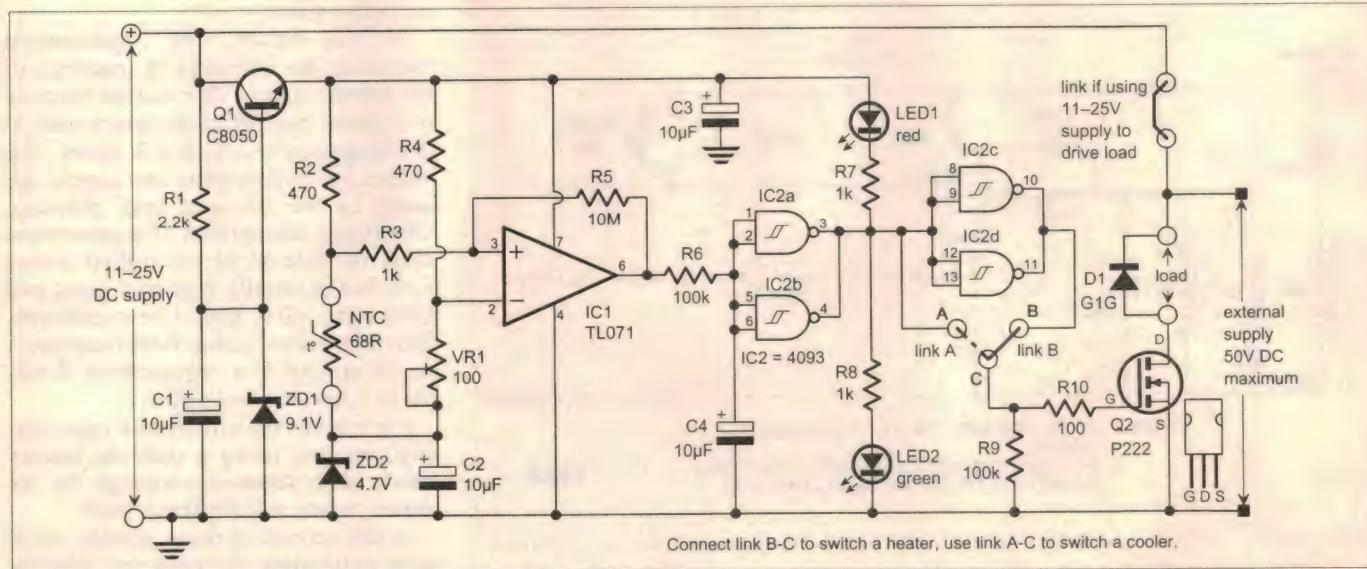
The power supply requirements are not critical, as the controller has its own voltage regulator. The supply voltage can be anywhere between 11V and 25V DC — although by leaving out a link, you can have one supply for the controller and another (up to 50V DC) for the load.

Adding a relay (see end of article for details of a suitable relay) will let you use this controller to switch mains-rated loads, such as an air conditioner, heating elements, light banks and so on. A diode is included on the circuit board to protect the MOSFET against the inductive back

EMF of a relay coil. By mounting the relay at the load, you can keep all mains voltages away from the controller.

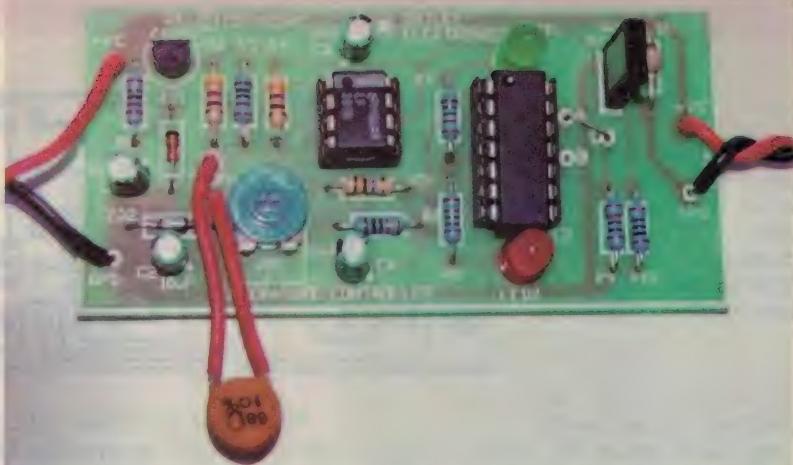
The temperature set point is determined by a potentiometer on the circuit board, although you can use an externally mounted pot. The temperature range is mainly determined by the type of thermistor. The thermistor supplied in the kit has a nominal resistance of 68Ω at 25°C, which drops to less than 10° at 100°C, rising to around 170Ω at 0°C. As you can see, the thermistor has a negative temperature coefficient, with resistance falling as temperature increases.

The thermistor looks like a ceramic disc capacitor, and has a diameter of about 10mm. Two are supplied in the kit. The thermistors have a 10% tolerance, so some readjustments could be needed when replacing a thermistor.

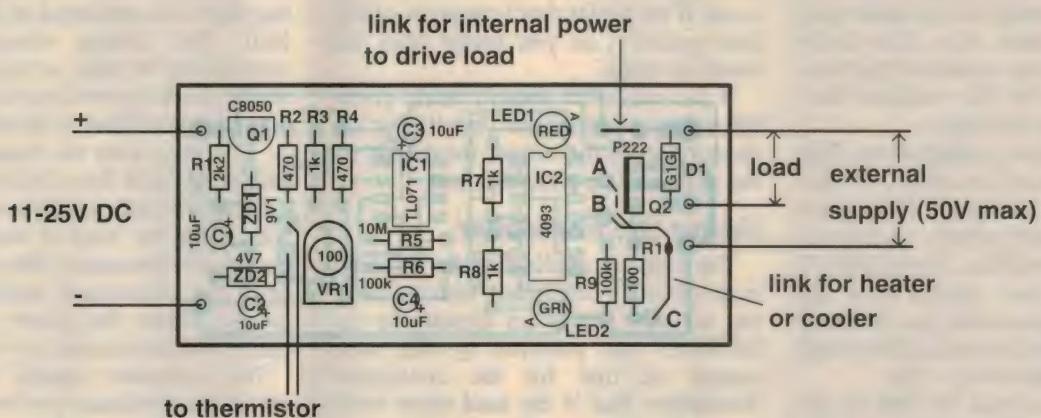


The supply voltage is regulated by Q1, while the circuitry around the op-amp forms the temperature control section. The op-amp output is inverted by IC2a and b to give control of a cooling system. For control of the heating system, the output from IC2c and d is used to drive the MOSFET.

Right: This temperature controller has an onboard MOSFET that can switch up to 500W. Use it to control the temperature of an incubator, plant box, aquarium and so on.



Below: Where the components are placed on the board. The MOSFET is mounted so the metal side faces towards the centre of the board. Link B-C is used to control a heater, link A-C for controlling a cooling system. Fit a heatsink to the MOSFET for a load current above 1.5A.



Now that we've explained what you can do with this device, let's look at how it works.

The circuit

Starting at the left of the circuit, Q1, R1, C1 and ZD1 form a voltage regulator to supply around 8V regulated DC to the rest of the circuit (except MOSFET Q2).

Op-amp IC1 and its associated circuitry form the actual temperature controller circuitry. The op-amp is connected as a comparator, with R5 and R3 providing a small amount of positive feedback to give about 50mV of hysteresis to the circuit.

The voltage at the negative input of the op-amp (pin 2) is determined by the setting of VR1 and is adjustable from around 4.35V to 5V. On the prototype, when VR1 is halfway, this voltage is 4.74V.

The voltage at the positive input of the op-amp (pin 3) is determined by the resistance of the thermistor. For the prototype, at 25°C this voltage is about 4.75V, or very close to the voltage at the negative input with VR1 set halfway.

As the temperature of the thermistor rises, its resistance drops, so the voltage at the positive input decreases with an increase in temperature.

When the voltage at the positive input is higher than that at the negative input, the output of the op-amp is high (at around 8V). The output of the op-amp connects via R6 to the inputs of IC2a and b, which are connected as inverters. Therefore the voltage at pins 3 and 4 of IC2 is low, and LED1 lights. If link A is connected, the MOSFET is off, and the load is turned off.

If link B is connected, the MOSFET is on, as IC2c and d again invert the output of IC2a and b. This will turn on the heating element and, if the thermistor is sensing the temperature around the element, the resistance of the thermistor will now start to drop. The voltage at the positive input will fall, and eventually the output of the op-amp will switch low, turning off the heating element. LED2 will now light, driven by the out-

put voltage of IC2a and b.

When the thermistor temperature cools, its resistance rises, increasing the voltage at the positive input of the op-amp. Eventually this voltage will exceed that at the negative input, and the cycle starts over again.

Resistor R6 and capacitor C4 give a delay between the output of the op-amp and the inputs of IC2a and b. This stops noise or oscillation at the output of the op-amp being fed to the rest of the circuit, including the MOSFET. Diode D1 protects the MOSFET from the back EMF of a relay coil.

The MOSFET has an on-resistance of around 0.15 ohm, and can work with voltages up to 50V DC. A link on the circuit board is removed to allow a separate supply to be used to power the load. We'll have more to say about that later.

Construction

There's very little work involved in building this circuit. All the components mount on the PCB, except the thermistor, which is placed in the temperature controlled zone, and connected with hook-up wire to the board. Of course, you can also mount VR1 and the LEDs off the PCB, perhaps on the front of an

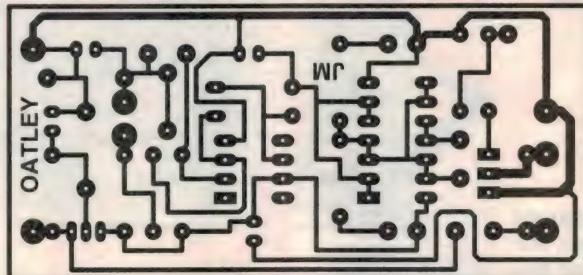
Kit available:

A kit of parts for this project is available from **Oatley Electronics**, of PO Box 89, Oatley NSW 2223. Phone (02) 9584 3563, fax (02) 9584 3561.

Orders by e-mail: oatley@world.net.

Price of the kit, including all components and PCB is \$21 plus \$4 P&P. A 12V relay with 8A contacts and 4kV isolation is a further \$3.

If you want to make your own PCB, here's the artwork, reproduced full size. The design is copyright to Oatley Electronics, and won't be available elsewhere.



enclosure for the board.

As usual, mount the passive components first (resistors, capacitors, wire links etc). Watch the polarity of the diodes and electrolytic capacitors. Also, if in doubt about the colour code of some of the five-band resistors in the kit, measure their resistance with an ohmmeter.

Now fit the active components. The ICs can be mounted in sockets or soldered directly to the board. Make sure you have the correct polarity for transistor Q1 and the two LEDs. The MOSFET is mounted last, and should have the metal side facing towards the centre of the PCB. A heatsink is needed for a load current greater than about 1.5A.

At this stage, include the link so the load can be powered from the supply for the rest of the circuit. If you are using the controller to operate a heater, also link between points B and C (link B) on the circuit board. To control a cooler, the link is between A and C.

Because of its relatively long leads, you can solder the thermistor directly to the board for testing purposes. Finally check over your work, looking for solder bridges, poor soldered joints or incorrectly mounted components.

Testing it

The easiest way to test the unit is to use a 12V lamp as the load. Connect this lamp to the load terminals, and apply at least 11V to the circuit (but no more than the rated voltage of the lamp.) Rest the thermistor near the lamp so it is heated by the lamp.

You should find the lamp will turn on when VR1 is set past the halfway point. The lamp will heat the thermistor, and eventually the lamp will turn off. The controller will cycle, with the lamp turning on and off with a duty cycle depending on where you've placed the thermistor. Note that the thermistor has some degree of thermal inertia, due to its size. This is fine for most applications, but means the controlled temperature will vary by a few degrees.

Make sure the LEDs light, in which the green LED is on when the load is off, and the red LED is on when the load is on. If the LEDs don't come on, check their polarity, as you might have the leads reversed.

If the controller doesn't work, check the voltages around the circuit. See the description of the circuit for details on the voltages you should expect.

Using the controller

The simplest application for this unit is as a heating controller, with the heating element connected directly to the MOSFET and powered by the same supply as that for the controller. Remember that if the load takes more than 1.5A or so, you'll need a heatsink on the MOSFET.

You can make a simple heating element from an old electric jug element. You'll obviously only use a section of the element, enough to give the required heat using the available supply voltage. Or you can use suitably rated lamps, such as a car

headlight. The heat from most incandescent lamps is around 90% of the wattage rating of the lamp, so a 50W car lamp will give around 40 to 45W of heat, often enough for a small enclosure.

Because the MOSFET can handle up to 50V, you can power the load from another supply, connected as shown in the circuit diagram. Disconnect the link between the cathode of D1 and the supply to the electronics. In theory, the MOSFET can pass up to 10A DC, giving a total power of 500W. However these are maximum values, and you'll definitely need a heatsink on the MOSFET!

For a large enclosure, you might need more heating power than the MOSFET can switch. In this case use a relay, with the relay coil connected as the MOSFET load. The heating element is now switched by the relay, so you can use any heater element providing its power rating doesn't exceed that of the relay contacts. A 12V relay with 8A mains-rated contacts is available from Oatley Electronics.

Mount the relay so all power or mains wiring for the load is away from the controller electronics. This not only protects the electronics against possible damage from the power wiring, but makes the circuit safe to work on.

The thermistor should be mounted within the enclosure you're heating, but away from the heating element. If you need to circulate the heat, fit a small fan inside the enclosure. In most cases, putting the heating element at the bottom of the enclosure is enough.

The thermistor supplied with the kit has a workable temperature range up to about 100°C. For a higher temperature, you'll need a different thermistor and to probably change a few component values. However, the supplied thermistor is suitable for an incubator, plant box, aquarium and so on. Fit the thermistor inside a waterproof container if using it to sense the temperature of a liquid. Use a piece of tubing made of metal or other heat conducting material, sealed at both ends with silicone glue or similar.

The controller can also be used with a cooling system, by connecting link A-C instead of A-B. However it can't be used to switch a Peltier device, as these require a different switching arrangement. The cooling unit will most likely have to be switched via a relay. The thermistor will operate down to about 0°C. You might want to swap the LEDs over, so the red LED indicates the cooling system is on, and the green LED when it's off.

So there it is, a simple little temperature controller that has lots of uses, many of which we probably haven't even thought of. ♦

PARTS LIST

Resistors

All resistors	1/4W unless noted:
R1	2.2k
R2,4	470 ohms
R3,7,8	1k
R5	10M
R6,9	100k
R10	100 ohms
VR1	100 ohm PC mount pot

Capacitors

C1-4	10uF RB electrolytic
------	----------------------

Semiconductors

IC1	TL071 op-amp
IC2	4093 quad NAND
Q1	C8050 NPN transistor
Q2	P222 N-channel 10A/50V MOSFET
ZD1	9.1V 350mW Zener
ZD2	4.7V 350mW Zener
LED1	5mm red LED
LED2	5mm green LED
D1	G1G, 1A 400V diode

Miscellaneous

68 ohm thermistor, PCB 75 x 35mm, 8-pin and 14-pin IC sockets, hookup wire.

OUR PRO SERIES 4 PREAMP: THE DSE KIT



After the considerable amount of time and effort that goes into developing projects here at *Electronics Australia*, we're always very interested in how these appear in kit form, as put together by various electronics retailers. We recently had a chance to check out some of the main components from the Dick Smith Electronics kit for our new Pro Series Four Preamplifier, and found clear evidence that they've invested a substantial amount of their own R&D time in preparing it.

As you can see from the photo, we were sent examples of the chassis, front panel, switch PCB and remote control unit from the DSE preamp kit. In short, we're happy to report that all of these parts are of a high quality, and should help constructors produce a neat and attractive Pro Series Four Preamp.

The remote control itself is of particular interest, since DSE's R&D department have redesigned the unit to suit quite a smart plastic case from their own range. The case measures 144 x 60 x 28mm, features a removable panel for battery access, and has enough internal space to fully enclose the PCB plus volume UP/DOWN momentary-action switches. This in turn allows the switches to be actuated through the remote's plastic legend panel, for a neat (and splash-proof) result.

The preamp's switch PCB has also undergone a degree of rearrangement, to suit DSE's range of rotary switches and matching knobs. In this case their R&D department have simply redesigned the PCB to suit their particular components, and as with the other changes and enhancements to the design, this appears to have been done



Amongst other changes, DSE have adapted our IR transmitter module to suit a case featuring neat hidden switches.

in a quite professional manner.

Other than that, DSE have taken a fairly elaborate approach to the preamp's chassis, which is a folded steel arrangement finished in the usual black 'powder coat'. The basic chassis is in this case a box in its own right, with its front panel ultimately covered by the preamp's silk-screened dress panel. This panel is formed from 2mm aluminium plate and features a black anodised finish, by the way.

As well as producing a chassis that is rather more rigid than our prototype unit, this approach also means that the headphone socket can be installed in the box front panel (in an indented hole), with the dress panel neatly covering the socket's nut. While we used a small right-angle bracket to achieve a similar result, DSE's 'double panel' arrangement is certainly a neater solution.

Of course, you can check out the results of DSE's efforts yourself at one of their many stores. They are currently offering the Playmaster Pro Series Four preamp kit for an all-up price of \$229, which includes the revamped remote control unit. (R.E.) ♦

THE NEW FLUKE 18 AUTOMOTIVE METER

Although it doesn't offer any specialised automotive testing functions, Fluke's new model 18 DMM is very easy to use and is claimed to offer all of the ranges necessary for making 80% of basic electrical measurements in a modern car. It also offers Fluke's traditional accuracy and reliability, at an affordable price.

by JIM ROWE

While the Fluke company has a reputation for making accurate, reliable and rugged test instruments, until recently its 'up market' image and the relatively high prices of its instruments have meant that most of them were used in labs and for field servicing by electronics technicians in large organisations. Nowadays, though, the company seems to be making a concerted drive to win a

larger market share; it has streamlined its manufacturing to achieve higher efficiency (hence more competitive pricing), and has also been producing more instruments targeting specific 'real world' applications. As a result, more and more people are now able to afford the traditional 'Fluke advantages'...

The new model 18 Automotive Meter is clearly part of this initiative. It's a

compact, rugged and easy to use little instrument, in this case designed to focus on automotive applications.

Actually although labelled an 'Automotive Meter', the model 18 doesn't have any specialised automotive testing functions like some of its bigger brothers. It's really just a good basic DMM (digital multimeter), able to measure volts DC and AC, resistance, continuity and capacitance, along with diode testing and accompanied by 'intelligent' features like auto ranging and min/max measurement monitoring.

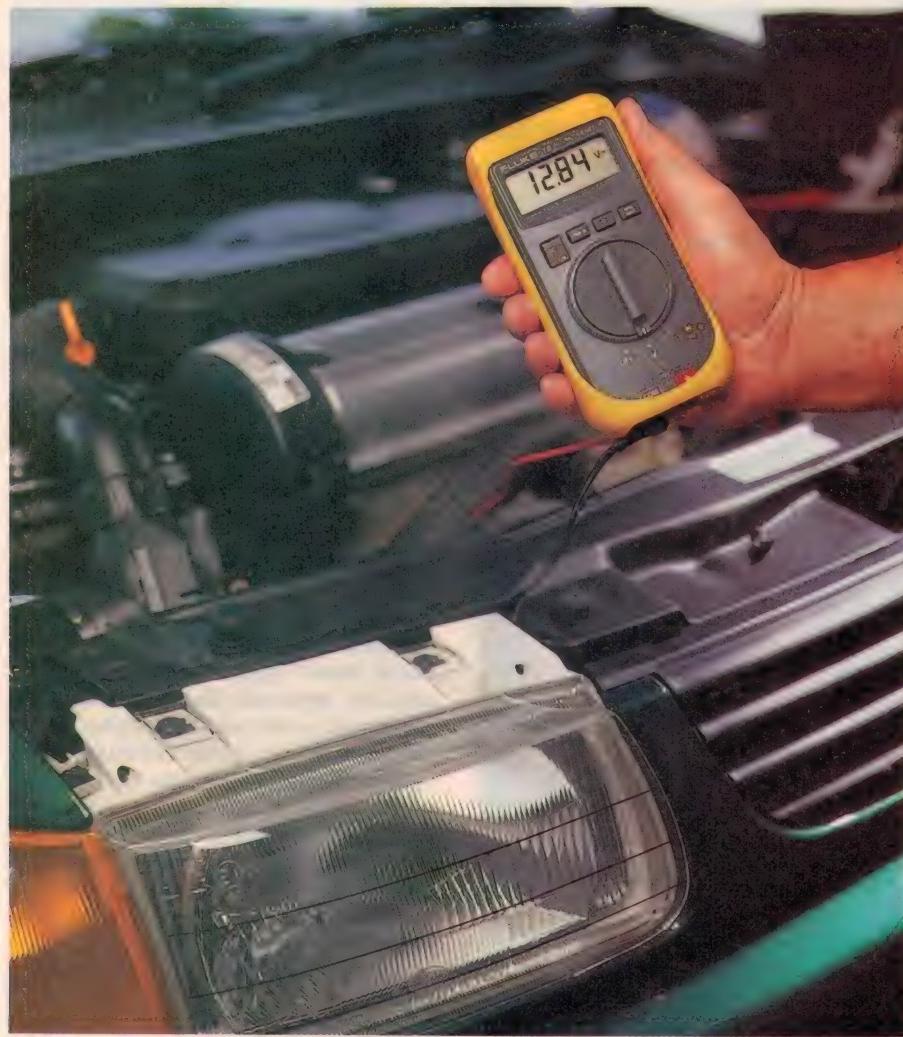
Why then call it an automotive meter? Simply because, as Fluke points out in its literature, some 80% of common electrical measurements on modern cars can be carried out with this type of instrument. This probably applies to measurements by service technicians just as much as those done by 'handyperson' car owners.

With the right technique, for example, a good basic DMM like the model 18 can be used to check things like battery condition, the voltage drop of starter connections, the alternator's output ripple (a good guide to the condition of the rectifier diodes), the resistance of spark plug HV leads, the continuity of wires in the main harness — even the output voltage from the exhaust oxygen sensor and some of the other sensors, if you wish. In short, it can be a big help in tracking down all but the most esoteric of automotive problems.

Of course it's also true that the model 18 will be equally useful for making a lot of measurements in other situations, around the home, office or workplace. It's the sort of DMM that one would be happy to recommend to almost anybody for making the majority of day-to-day measurements.

A closer look

In more detail, the model 18 measures a compact 142.3 x 70.5 x 34.6mm, and weighs 286 grams. It's a 3-3/4 digit



Fluke's new Model 18: features include automatic DC blocking on the ACV ranges, to allow fast measurement of alternator ripple.

(4000 count) instrument, with a high-contrast LCD display updated four times a second. As you can see from the photo, it comes complete with a protective synthetic rubber holster. Also included are a set of high quality test leads and clips, and operating instructions in no less than 14 different languages!

There are nominally five measurement ranges for both DC and AC voltage, although in each case the lowest two are essentially the same range with different scaling: either 0 - 4.000V or 0 - 4000mV (the latter being provided to suit planned accessories). The remaining ranges on each mode have full-scale figures of 40.00V, 400.0V and 0600V. In each case it's possible to change range manually if you wish to over-ride the auto ranging. Another point is that the instrument is automatically AC-coupled for AC measurements — making it easy to measure things like AC ripple on the DC alternator output.

There are six resistance ranges, with full-scale readings from 400.0Ω to 40.00MΩ. And for capacitance there are four ranges, with FS readings from 1.000uF to 10,000uF. The remaining diode/continuity range indicates diode forward drop on a 2.000V scale, and the beeper sounds for resistive paths which drop below 25Ω.

Rated measurement accuracy for the higher DCV ranges is $+/- (0.9\% + 1 \text{ digit})$, with an additional digit added on the lowest range. For each of the ACV ranges it's $+/- (1.9\% + 3 \text{ digits})$, while for most of the resistance ranges it's $+/- (0.9\% + 1 \text{ digit})$, extending to $+/- (1\% + 3 \text{ digits})$ on the top range. The corresponding figure for the capacitance ranges, for readings below 1000uF, is $+/- (1.9\% + 2 \text{ digits})$. These fig-

ures are of course more than adequate for all day-to-day measurements.

As you'd expect from Fluke, the model 18 also has impressive ratings in terms of shock and vibration resistance, and of course safety. For example it's rated to withstand one 'meter shock' as specified in MIL-T-28800D for a Class 3 instrument. On the safety side it provides Protection Class II requirements for UL1244, ANSI/ISA-S82, CSA C22.2 No. 231 and VDE 0411, and IEC 1010 over-voltage Category III (CAT III). It also complies with the following EMI regulations: FCC Part 15, Class B; VDE 0871B; EN 61010-1:1993.

Power for the DMM comes from a 216-type 9V battery. An alkaline battery gives a rated life of 650 hours continuous, while a standard carbon-zinc type gives about 450 hours.

By the way, the model 18 carries an impressive three-year warranty.

Trying one out

We were sent a sample of the model 18 by Dick Smith Electronics, which is selling it via its new Powerhouse store (Bankstown), North Ryde showroom, York Street (Sydney), Bourke Street (Melbourne) and Brisbane City stores. It's also available from DSE's mail order department, and also on order from the company's other stores.

Checked against our reference instruments, the model 18 easily met its specs on all ranges. In fact its measured accuracy was considerably better than the rated figures, suggesting that like other Fluke meters it's likely to remain within the specs for an extended period.

We also tried using the meter to make a range of measurements, both on a typical modern car and on various jobs around the home and office. In each situation we found it easy to use and stable in its readings.

Overall, then, the Fluke model 18 seems an excellent little meter and eminently suitable not only for automotive work but for a wide range of day-to-day testing. At the quoted RRP of \$219 it should also allow more users than ever to experience Fluke performance and reliability.

Further information on the model 18 or other Fluke instruments is available from Dick Smith Electronics, as well as from other Fluke dealers. DSE lists the model 18 in its catalog as the Q1636.

Incidentally DSE has very kindly made available a sample Fluke 18 meter as a competition prize, to be won by a lucky EA reader. See the announcement at right for details. Why not enter, and try to win this fine instrument for yourself? ♦



WIN A FLUKE 18 AUTOMOTIVE METER FOR YOURSELF!

As a special introductory offer to *Electronics Australia* readers, Dick Smith Electronics has generously donated one of these units — valued at \$219 — for us to give away as a prize. So here's YOUR chance to win one of these extremely



useful and high quality instruments...

All you have to do is share with us, in 250 words or less, an interesting or amusing experience you've had while trying to fix a problem with a car or other vehicle — preferably, an electrical or electronic problem. Or, you may have a worthwhile tip you can pass on, about faultfinding in a vehicle.

All entries must reach the *Electronics Australia* office by Friday, May 30 1997. Our judges will then pick the entry they find most interesting, amusing and/or useful, and then award the Fluke Model 18 to the sender of that entry. What could be simpler?

Send your entry to 'Electronics Australia/DSE Win a Fluke 18 Competition', PO Box 199, Alexandria 2015.

The Fluke 18 Automotive Meter is on display at the following Dick Smith Electronics stores: the Powerhouse (Canterbury Road, Bankstown); North Ryde Showroom; York Street, Sydney; Brisbane City; and Bourke Street, Melbourne. Listed in the DSE catalog as Q1636, it is also available on order from the company's other stores and Mail Order department.

This competition is only open to Australian residents. Entries received after the closing date will not be included. Employees of the Hannan Group or Dick Smith Electronics, their subsidiaries and families are not eligible to enter. The prize is not transferable and may not be converted into cash. The judges' decision is final and no correspondence will be entered into. Description of the competition forms a part of the competition. The competition commences 23.4.97 and closes last mail 30.5.97. The judging will take place in Sydney on 4.6.97 at 11am and the winner will be notified by mail and announced in a later edition of *Electronics Australia*. The prize is a Fluke Model 18 Automotive Meter valued at \$219. Total prize value \$219.



SUSI TO RUN A RULER OVER THE STARS

How do you measure how big a distant star really is, and how far away it is? These are the sort of questions that Sydney University's Stellar Interferometer — SUSI — is expected to help answer, when it's completed and fully operational. Geoff McNamara paid a visit to Narrabri in NSW, to find out how this very sophisticated high-tech optical system works...

by GEOFF McNAMARA

"It looks complicated, and it *is* complicated!" Bill Tango grinned. I couldn't disagree with him. Spread out on the 'Blue Table' was a mind- and light-bending array of lenses and mirrors. This was the business end of the Sydney University Stellar Interferometer, better known by its acronym SUSI. Built on the site of the Australia Telescope near Narrabri in northern New South Wales, SUSI is one of the most sophisticated

optical instruments in the world; it is certainly unique. But SUSI's task is as simple in description as it is complex in nature: to determine the fundamental properties of stars.

The problem with studying stars is that it involves the 'black box' method of research: you can look at them, measure their brightness, weigh them, even take their temperatures. The problem is that these factors are based on assumptions of

how big and how far away they are, something not easy to determine and never known with absolute certainty.

Because of their tremendous distance from us, the stars appear through even the largest Earth-based telescopes just as they do to the naked eye — points of light. It's just not possible to measure the size of the stars using these instruments.

This where SUSI comes in. SUSI is the brainchild of Bill Tango, from the

Opposite page: An aerial view of SUSI showing the siderostat stations, optical path length compensator building and the main building. (Courtesy Bill Tango, Sydney University)

Right: SUSI's control room, where the operators monitor and control its operation, and supervise data collection. (Courtesy Geoff McNamara)

Chatterton Astronomy Department at the University of Sydney. SUSI works on the principle that *resolution* — the ability of a telescope to see fine detail — is a function of *aperture*, or the size of the telescope mirror. Build a bigger mirror and you can see finer detail. There's a limit to how big a telescope mirror can be made, however, and for optical telescopes that limit seems to be about 10 metres. Larger telescopes would be almost impossible to construct and manipulate within reasonable cost limits.

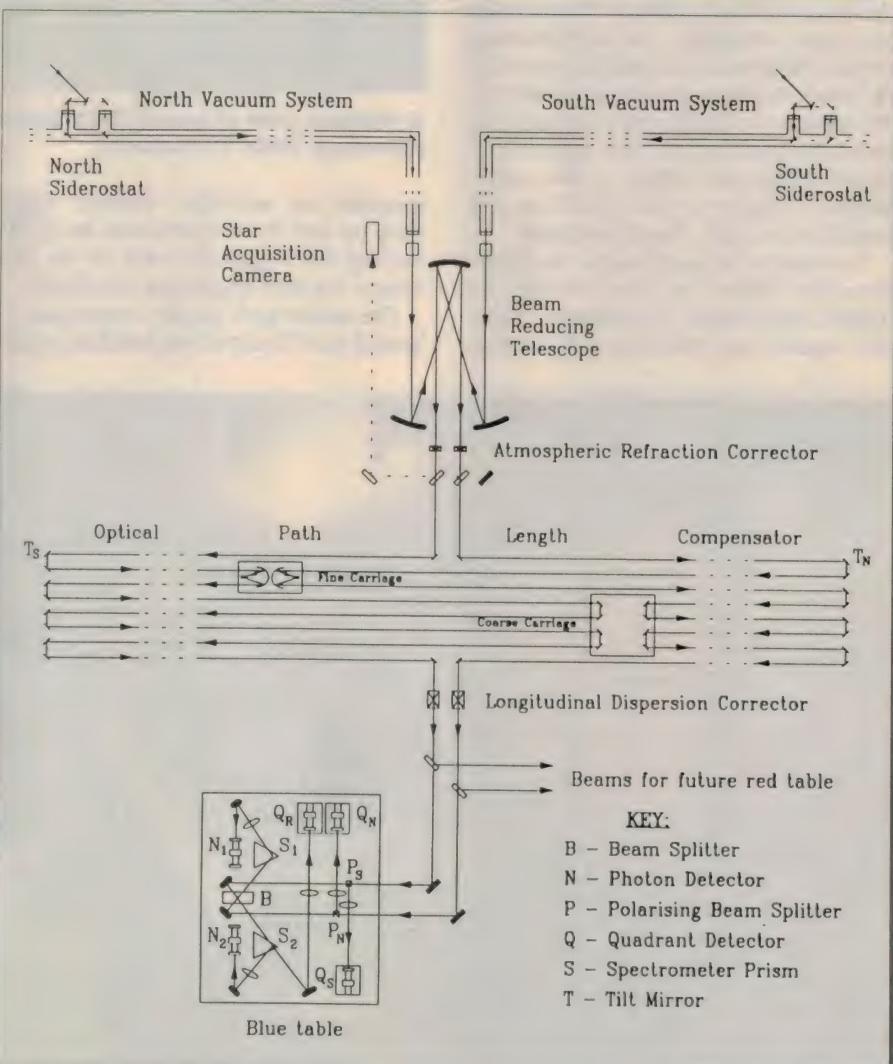
The alternative is to use a technique called interferometry. Using this principle, astronomers collect the light from two widely-spaced small mirrors as if they represented the two edges of a single, much larger mirror, and then combine the light to form an 'image'. The technique has been used with great success in radio astronomy, resulting in such spectacular technological achievements as the Australia Telescope Compact Array and the planned Space VLBI project (see *Electronics Australia* December 1995).

More demanding

When it comes to optical wavelengths, however, the tolerances on everything become much more demanding. "The radio people have it easy", Tango pointed out, "they measure everything in centimetres or metres; we have to measure everything in nanometres!" For this reason, everything about SUSI has to be done to extremely fine tolerances.

The 'front end' of SUSI is a series of small mirrors called *siderostats*, which track the stars across the sky. These mirrors are spaced out along the length of a 640-metre long evacuated pipe, which runs in a north-south orientation. The siderostats work in pairs, one in the northern and the other in the southern end of the pipe, collecting starlight and channelling it into the pipe through optical windows.

By selecting different pairs with different separations, the astronomers can synthesise different apertures, or baselines, depending on the nature of the observation being made. Midway between the two sets of siderostats the light is redirected into a beam-reducing telescope, which collects and focuses



Here's the overall optical layout for SUSI, showing how it all works together. Both main siderostat arms are evacuated, as you can see. Note the star acquisition camera, with its takeoff just after the beam reducing telescope. (Courtesy Bill Tango, Sydney University)

SUSI to run a ruler over the stars

the light into a tight beam.

The purpose of collecting the light from the siderostats is not to form an image like a normal telescope, but rather to form an interference pattern from which the astronomers can learn about the star under observation. It's important, therefore, that the light from the two mirrors has travelled the same distance. But because the mirrors are separated, one will always be closer to the star than the other. For example, if SUSI is looking at a star in the northern sky, the light from the star will reach the northern mirror before it reaches the southern mirror. The difference can amount to several hundred metres.

Compensating crucial

This difference may seem trivial after the multi-lightyear journey the photons have just completed, but compensating for the difference in distance is essential if the interferometer is to work successfully. "In order to see interference you've got to match the paths of the two arms of the interferometer to within a few wavelengths of light, or you won't see any interference at all", Tango explained.

To equalise the path length, the beams from the mirrors are sent through the 'optical path length compensator'. There the beams are reflected off mirrors



A closeup view of one of the siderostats, with its protective roof rolled back. (Courtesy Geoff McNamara)

mounted on moveable trolleys, which slide up and down a precision track. By varying the length for each of the two beams, the path lengths are equalised.

The optical path length compensator is housed in a 70-metre long building, which

is itself surrounded by another building to keep the temperature constant. Because it's not evacuated like the pipe joining the siderostats, air turbulence in the compensator is a major consideration.

"Ordinarily we don't let people in here," Tango explained as I prepared to photograph the dimly-lit tunnel. "It completely wrecks the stability of the air for several hours." The compensator is actually two buildings, one inside the other. The outer building is air conditioned to keep the inner one cool during the hot Narrabri summer.

Once the path lengths have been equalised, the two beams are sent on to the Blue Table, where they go through a series of refinements before being combined to produce the interference pattern.

One of the problems with combining the beams is that they are both reaching the siderostats via the Earth's turbulent atmosphere. To compensate, SUSI employs a technique called adaptive optics (see EA January 1996).

First in Australia

"This was the first adaptive optics system in Australia", Tango points out. SUSI uses a system of tip-tilt and flexible mirrors to monitor and compensate for the distortions caused by the atmosphere. The result is perfectly collimated beams that can be combined to form the interference pattern.

So what does SUSI actually do?



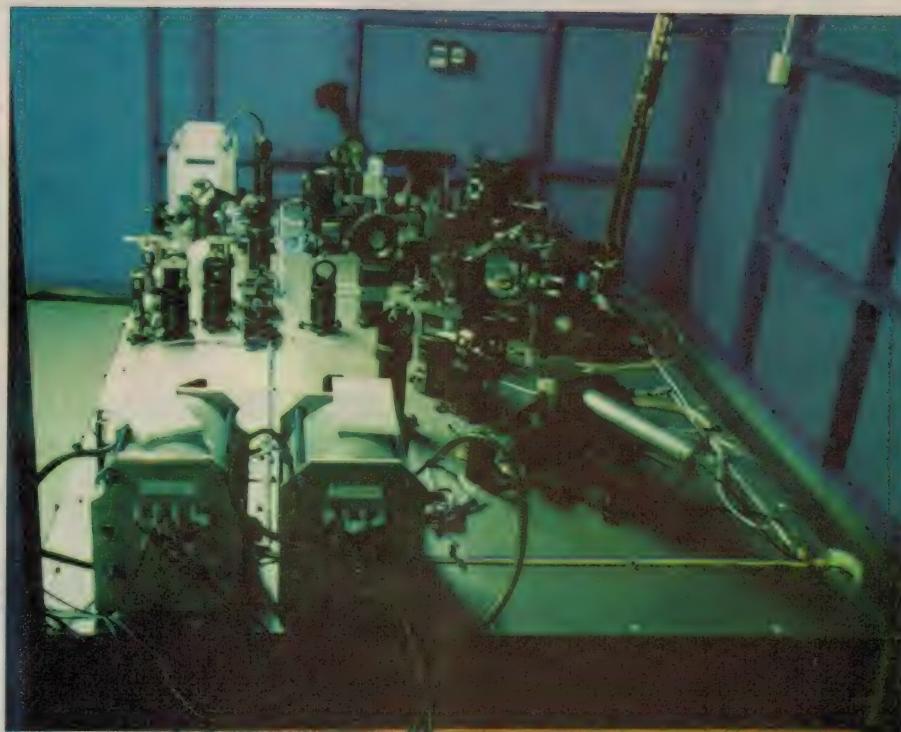
Inside the optical path length compensator, where moveable mirror carriages are used to equalise paths from the siderostat pair in use. (Courtesy Geoff McNamara)

The heart of SUSI: the 'Blue Table', where the beams finally reach the detectors for comparison. (Courtesy Geoff McNamara)

"What we need is something to keep the theoreticians honest", Tango explained. Theoretical astronomers would like the input of direct observations. SUSI won't only provide information on the diameters of stars and their distances, but also the physical properties of binary stars, and the behaviour of certain types of variable stars that can help determine the size of the Universe. "There's heaps and heaps and heaps of things to do with SUSI", boasts Tango.

Work on SUSI is not complete. "Eventually, we will be able to combine the light from any station on the northern arm with any station on the southern arm, and that gives us a range of base lines from five metres to 640 metres", Tango said. "Currently, the maximum baseline is 80 metres."

The 640-metre baseline is some way off, but will permit a resolution equivalent to seeing a human hair from a distance of 100 kilometres. This amazing resolution, when turned on the sky, will give astronomers a clarity of vision unlike anything they've experi-



enced before. Not only is SUSI a brilliant example of technology, but its potential for adding to our knowledge of the Universe is vast.

Geoff McNamara is a freelance sci-

ence writer based in Sydney, and a frequent contributor to Electronics Australia. He would like to thank Bill Tango from the University of Sydney for his help in preparing this article. ♦

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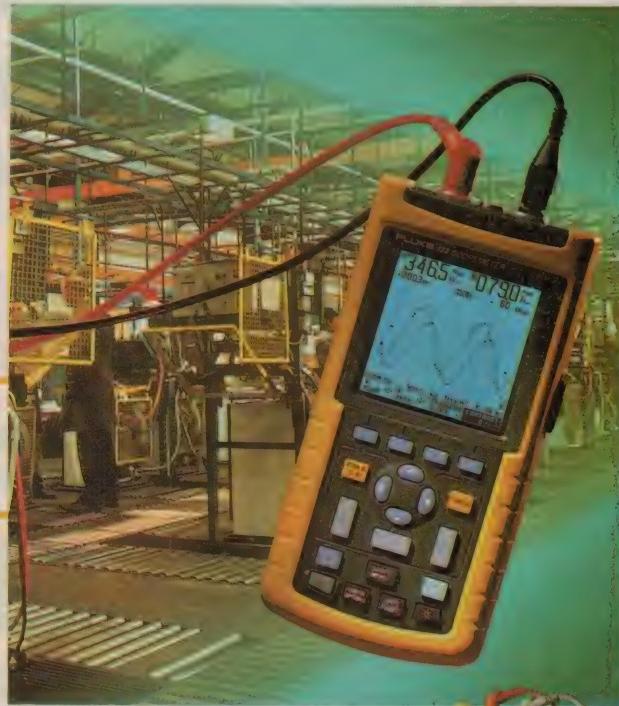
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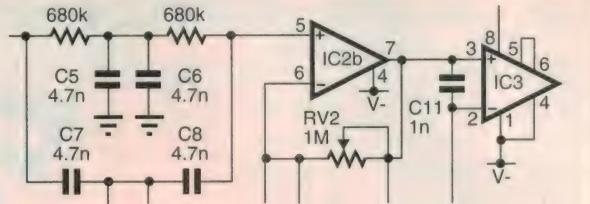


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\$10 Wonders

by OWEN BISHOP



2: A water alarm

In this, the second in our series of low cost, easy to build projects, the author presents a simple water alarm, capable of warning you of one of those sudden downpours. As in all of the projects in this series, the alarm is built on a small piece of stripboard and can be constructed for well under our \$10 limit.

At home, we have a really sneaky watering system that switches itself on ever so quietly and, before you know what has happened, everything is bathed in a fine saturating mist. We have to remember to close one particular bedroom window, to protect the room from a jet that happens to be aimed straight towards the house, and recliner chairs on our favourite area of the patio are liable to a soaking if we don't remove them in time.

This is why this water alarm is so useful. At the first spurt of water it sounds a distinctively mournful note, and keeps on with an ever-rising pitch until you switch it off. The water alarm has other uses too, for it does rain in Perth occasionally — sometimes unexpectedly — and the alarm watches over the washing drying on the line. We can also hang it over the edge of the pool when we are topping it up and, after an hour or so, the alarm reminds us that the water has risen to the required level.

What's a UJT?

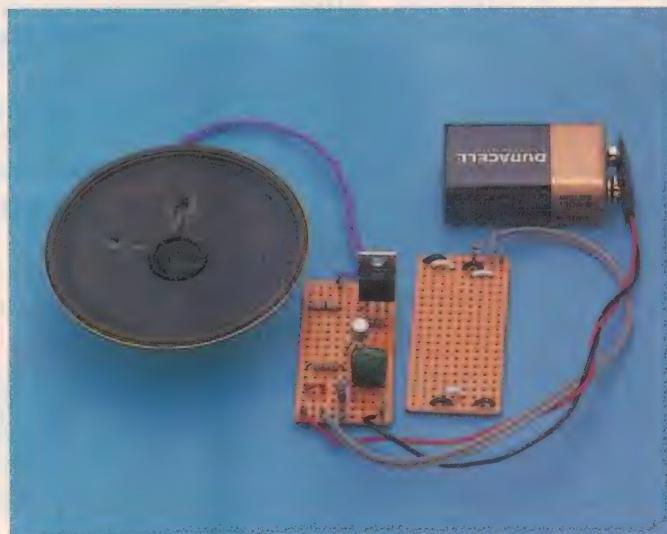
This circuit is based on one of those less often used semiconductor devices, a *unijunction transistor* or as it is more commonly known, a UJT.

The UJT is relatively expensive but does a job that otherwise requires several components. It consists of a rod of N-type semiconductor with a region of P-type near one end. This is formed in manufacture when the N-type piece of silicon is heated with a rod of aluminium in contact with it. Aluminium atoms diffuse into the N-type material and convert it to a P-type region, the emitter. (Fig.1 shows the construction in detail.)

This gives us just one P-N junction; hence the name 'unijunction'.

In action, base 2 is made more positive than base 1. A small current flows and there is a voltage gradient along the rod. The voltage in the region of the P-

The water alarm can not only help rescue the washing from sudden storms, but also monitor basements for signs of flooding or even help in filling the swimming pool.



type material has a fixed intermediate value, depending on its position along the gradient.

If a voltage is applied to the P-type region, and this voltage is less than the fixed intermediate voltage, the P-N junction is reverse-biased and no current flows from the emitter. But, if the external voltage is increased gradually, it reaches a level known as the peak point

at which the junction becomes forward biased. Then current flows from the emitter to base 1.

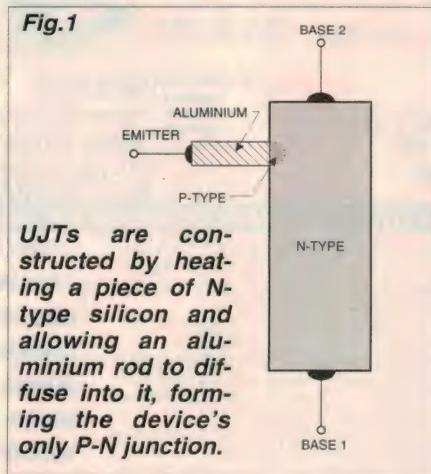
The action is more complicated than simply a flow of current through the base. Large numbers of holes are swept from the emitter into the base, increasing the conductivity of the region between the emitter and the base 1 terminal. A very large current can flow, typically several amps.

The circuit

The properties of the UJT are made use of in the audio oscillator section of our water alert (Fig.2). A small current flows through R2, the UJT and R3, creating a voltage gradient between the bases b1 and b2. The emitter is connected to one of a pair of probes (via R1), while the other probe is connected to the positive line. No current can flow into the emitter until there is a path between the two probes, and in this case, this path is only provided by a drop of water.

Once current flows from the positive rail, through the first probe, through the water droplet to the other probe, then

Fig.1



even though the conductivity of water is low, it takes only a few seconds for a charge to build up on the capacitor C1.

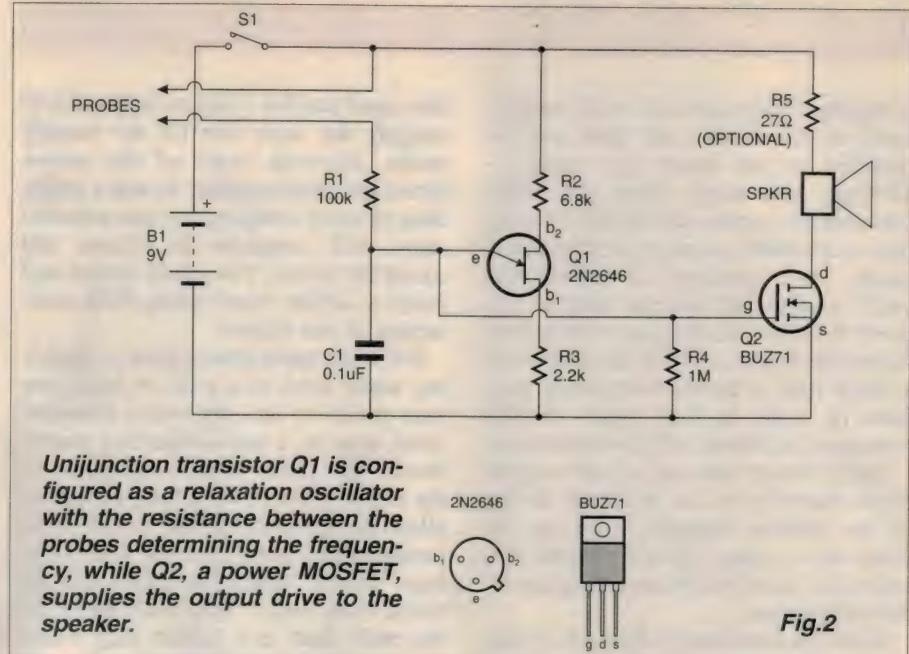
As soon as the voltage across C1 reaches the UJT's peak point, a large flow of current from emitter to b1 partly discharges C1. Its voltage falls below the peak point and the discharge ceases, but begins again as soon as the voltage reaches the peak point again. Thus we have an oscillating action. The voltage across C1 rises slowly and falls quickly, creating a sawtooth waveform. The bursts of current through R3 create a rectangular pulse signal at b1. If we choose a suitable value for C1, the frequency of the sawtooth waveform will be in the audio range.

If R3 is replaced by a loudspeaker, the UJT can drive it directly, but this means relatively high quiescent current and is wasteful in a circuit that has to run for hours at a time. Also the amplitude of the signal is limited by the peak point; so we use relatively high-value resistors for R2 and R3, to allow only small currents, and amplify the signal power with a MOSFET amplifier Q2.

In fact Q2 is used here just as a switch, which turns the current to the loudspeaker on or off. The MOSFET can be driven either by the sawtooth signal at the emitter or the rectangular pulses at b1, but in this circuit I decided to use the sawtooth as it gives a more pleasing sound. (also, the small quiescent current through R3 would leave the MOSFET switched on and a fairly heavy quiescent current flowing through the loudspeaker.)

If conduction between the probes ceases, the circuit stops oscillating, which leaves a small charge on C1. R4 lets this charge flow away, so reducing the gate voltage of Q2 to zero and turning the MOSFET fully off.

Since we are limited to a \$10 budget, we can allow only about \$2.50 for



the speaker. This means using a small low-cost, low-power (about 0.25W) speaker. R5 limits the power and the sound volume, though this is still quite loud enough.

If you have a speaker of 1W or more, omit R5 and connect the speaker directly to the +9V line. The noise is deafening! A BUZ71 is a power MOSFET capable of handling 14 amps, so do not worry about overloading it. Its 'on' resistance is a mere 0.18Ω , so most of the supply voltage is developed across the speaker (and R5 if fitted).

Construction

The quiescent current of the circuit is only $650\mu\text{A}$ or so, so a PP3 9V alkaline battery should last for several weeks of continuous operation.

The circuit is assembled on a scrap of stripboard, and if you follow the component overlay diagram (Fig.3) you shouldn't have any problems in putting

Parts list

Resistors

Carbon 5% or metallised film 1%, 0.25W:
R1 100k
R2 6.8k
R3 2.2k
R4 1M
R5 27 ohms (optional, see text)

Capacitors

C1	0.1uF, MKT or metallised polyester (Greencap)
----	---

Semiconductors

Q1	2N2646 unijunction transistor
Q2	BUZ71 or MTP3055 power MOSFET

Miscellaneous

LS1 8 ohm loudspeaker, 0.25W to 1W; 0.1" stripboard 25mm x 47mm (9 strips x 18 holes); scrap of stripboard for probe, 8 x 1mm terminal pins; miniature panel-mounting slide-switch; 3.5mm mono plug (optional); 3.5mm mono panel-mounting socket (optional); PP3 9V battery clip.

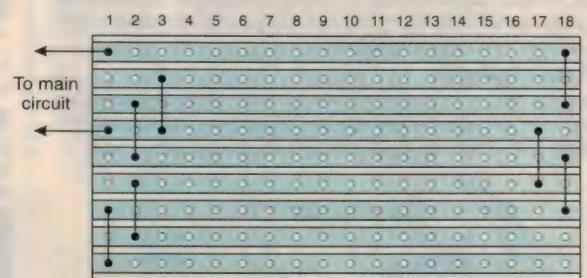
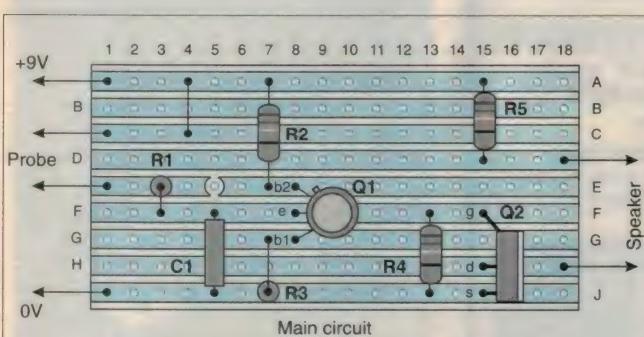


Fig.3

The left layout shows the position of all the components in the alarm, as well as the cut in the track at E5. At the right is the wiring for the sensing probe.

it together. There are only eight components on the board, and these can be installed in just about any order — although you might leave the taller components, such as the MOSFET until last, as it makes construction that much easier. And speaking of MOSFETs, you'll notice that the gate lead of Q2 needs to be bent slightly in order to fit it in its proper place, at F15. Be sure to use a small pair of pliers to carefully preform its leads, as they aren't terribly robust and can break off if over stressed.

Don't forget that one of the copper tracks needs to be cut, at E5, as shown in the overlay diagram. This can be done with a large (5-10mm) drill bit, and is best done before mounting any of the components.

Although not strictly necessary, it is a good idea to install six PC pins on the board where you'll need to connect the wires to the battery, probe, and speaker. (This makes the final wiring of the circuit that much easier, and you don't have to worry about odd strands of wire shorting between tracks.)

As well as the 9 x 18 hole piece of stripboard for the main circuit, you will

also need another scrap of stripboard of roughly the same size for the sensing probe. Alternate strips of this sensor board are wired together so that a single drop of water bridging any two adjacent strips will complete the circuit and sound the alarm. You could design and make a similar board using PCB techniques, if you wanted.

For some applications, such as detecting water level in a pool or tank, you may prefer to use two wires mounted 1mm apart in a non-conducting plastic block. The probe is best connected to the end of a pair of wires long enough to allow the main part of the circuit to be located safely away from the water, perhaps indoors where the alarm will be heard more easily. You could terminate the probe lead in a 3.5mm plug which fits a 3.5mm socket mounted on the side of the enclosure; this enclosure (if you use one) can be a cheap ABS plastic box with an aperture cut for the loudspeaker, and holes for mounting the socket and switch. The circuit board is small enough to be fixed securely on the bottom of the box using a lump of Blutac, or a double-sided adhesive pad.

To test the circuit, place the probe board strip side up and let a drop of water fall on it. The pitch of the noise depends on the current flow, so it is high at first, falling as the drop evaporates. You'll find that the pitch rises further if you add another drop, as you are effectively lowering the resistance between the probes with every drop of water.

When in use, the pitch of the alarm will depend partly on the exact peak point of the UJT you are using, and the number and conductivity of the droplets. By increasing the number of strips or lengthening the probe, you can increase the chance of a rain drop hitting your sensor well before your washing starts to get damp. If you find that the pitch of the alarm is too high with only one drop of water on the probes, you can lower the frequency by increasing the value of R1, or replacing C1 with a larger value (0.22uF for example).

Finally, the circuit needs an enclosure if maximum speaker volume is to be obtained. If you have an old radio set, tape player or intercom station that has a working speaker, you can save money by stripping out everything but the speaker. With luck, the old equipment will have a speaker rated at 1W or more, so your water alarm will never sound unheard. ♦

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THANK GOD FOR THE SALVOS

SHORTWAVE LISTENING

with Arthur Cushen, MBE



Australia's overseas voice under discussion

The release of the Mansfield Report on January 24 gave an insight into the suggested future for the ABC and also Radio Australia which is funded from ABC funds. The proposals, 19 in all, looked at drastic cuts in ABC television, closing of the ABC TV satellite service to Asia and the closure of Radio Australia.

Recently the Australian Senate voted to refer the question of the future of Radio Australia to an enquiry of the Foreign Affairs Committee. The enquiry will look at the contribution to Australia's foreign policy and State interests of Radio Australia, and will also look at the activities of similar radio and TV broadcasting to the Asian and Pacific region. This enquiry will conclude by May 14th and readers who have thoughts about the future of Radio Australia should write to the Secretary, Australian Senate Foreign Affairs Committee, Canberra.

A similar situation emerged in Canada last December. The CBC would no longer fund Radio Canada International, but two Government Ministers and other agencies worked together to find sufficient funds to keep Radio Canada in operation for the future. It is very likely that the Australian Government will have to do likewise, if the estimated audience of 100 million in the Pacific Asian area is not to be lost.

Those many stations in the South Pacific who relay Radio Australia news to the local audience would also be lost, and countless thousands of New Zealanders would miss their favourite sporting relays on the ABC Sporting Service.

The history of RA

On the evening of December 20, 1939, the then Prime Minister Robert Menzies was heard inaugurating a permanent Australian overseas broadcasting service with the words: "The time has come to speak for ourselves". This was Australia Calling, which some six years later became Radio Australia.

In 1989 Radio Australia celebrated its jubilee. Acknowledged as having a major share of the shortwave audiences in many Asian and Pacific countries, it continued to speak for Australia and Australians at that time in nine different languages, reaching an audience which numbered more than 50 million regular listeners.

During the war years, Australia Calling became a vital source of news and information for people throughout Asia and the Pacific. The objective, unembellished treatment of its news reports quickly gained the service respect as an international broadcaster, and led to widespread acknowledgement.

ment of its authority and credibility.

Radio Australia's earlier role was to broadcast to North and South America, Europe and Africa in the languages of those countries, but later during the war with the Japanese conquest into the South Pacific, the switch was made to Asian languages and broadcasts were made in Mandarin, Japanese, Malay, Thai, Dutch, French and English.

In 1950 Radio Australia became a permanent division of the ABC, thus ensuring its independence from the Australian Government — an important factor in maintaining the station's credibility and acceptance abroad. In 1960 Japanese, which had been abandoned in 1947, returned to the airwaves.

Vietnamese broadcasts started in 1962 and Cantonese two years later. The Papua New Guinea service started in 1973 with English programmes, expanding to include Tok Pisin within the first year of operation.

In recent years budget cuts have severely reduced Radio Australia's coverage, commencing with transmitters at Shepparton and later at Darwin, Carnarvon and Brandon. In late 1996 the Carnarvon transmitting site was closed in West Australia and the transmitters were moved. This resulted in the situation of Shepparton having six 100kW transmitters and one 50kW; Darwin five 250kW; and Brandon three 10kW transmitters. The language schedule has also been reduced.

Listeners overseas, particularly in New Zealand, find Radio Australia a source of tremendous sporting information and their sports service at the weekend has many listeners in the Pacific area. Radio Australia's news is relayed by many Pacific Island stations and of course, is one of the satellite signals which is carried by WRN: World Radio Network. ♦

AROUND THE WORLD

ARMENIA: Voice of Armenia, Yerevan has been noted with an interval signal at 1630UTC on 4990kHz, then an extensive frequency announcement and a programme of local music.

ETHIOPIA: Radio Ethiopia External Service in English is now broadcast from 1600-1700 on 7165kHz, 9560 and 11,800kHz. News is at 1630 everyday. There is also a relay of the national service at 1030-1100 Monday to Friday on 5990kHz, 7110 and 9705kHz. Send reports to External Service, Radio Ethiopia, PO Box 654, Addis Ababa, Ethiopia.

INDIA: All India Radio, Shimla is heard on a Tuesday with an English discussion programme 1615-1630 on 3225kHz. At the end it was announced that the programme was from the National Service of AIR, Delhi.

IRELAND: West Coast Radio has changed its frequency for the broadcast 1500-1600UTC; it is now on 5970kHz. The best reception in this area is the transmission on Thursday 1800-1900 on 11,665kHz, which includes answering listeners' letters around 1850UTC.

NEW ZEALAND: RNZI's schedule became effective at 1900UTC on 29 March 1997: 1650UTC opening on 6070kHz; 1853 on 9795kHz; 1952 on 11,735kHz; 2307 on 15,115kHz; 0458 on 9795kHz and 0816-1205 on 9700kHz. At weekends there are some slight variations in the schedule.

PAPUA NEW GUINEA: Port Moresby has a new schedule, operating 2200-0900 on 9675kHz and 1930-2200 and 0900-1200 on 4890kHz. They also run all night 1200-1930 on 4890kHz, but generally only announce 100FM. There has been plenty of election promotion in the Friday broadcast, while in the all-night session reference is made to the fact that Port Moresby still has a curfew from 10pm to 4am.

RUSSIA: The Voice of Russia, Moscow has English to Australasia 0600-0800 on 12,025kHz, 15,470, 17,570 and 21,790kHz; 0800-0900 on 9875, 12,025kHz; and 0900-1100 on 9675kHz, 9835, 9875 and 17,860kHz. Moscow Mailbag is heard at 1000 on Monday, Tuesday and Friday. Mailbag can also be heard at 0700 on Wednesday and Saturday, and at 0600 on Monday, with Joe Adamov.

SRI LANKA: SLBC is heard opening at 1030UTC with an English announcement and programme review on 11,835kHz.

TAIWAN: VOFC is relaying WYFR with a gospel programme in English 1300-1400UTC on 9985kHz.

USA: Radio Free Asia is heard in Vietnamese 2230-2330 on 5990kHz and 7415kHz; 1400-1500 on 5950kHz, 7490 and 7520kHz. Also heard in Burmese 2200-2300 on 5940kHz, 7455 and 7515kHz, and 1500-1600 on 7490kHz, 7540 and 9440kHz. ♦

This item was contributed by Arthur Cushen, 212 Earn Street, Invercargill, New Zealand who would be pleased to supply additional information on medium and shortwave listening. All times are quoted in UTC (GMT) which is 10 hours behind Australian Eastern Standard Time and 12 hours behind New Zealand Standard Time.

New PLL 'building block' modules let you

GENERATE SIGNALS AT HF, VHF OR UHF - 4

In this fourth and final article of his short series describing two new phase-locked loop modules for VHF and UHF, the author discusses the software used to support the enhanced PC-Driven RF Sweeper. He gives some interesting examples of the enhanced Sweeper's many applications, and also explains how to extend its frequency range even higher using the YAPLL-U module.

by TIBOR BECE

With the VHF extension to the basic RF DDS sweeper, it becomes necessary to switch the RF signal path inside the unit. As you can see from Fig.11 (last article), the previously unused pin 14 output of the printer port is used for this purpose, to control the relays and PLL power via Q1 and Q2. The new version of the YADDS Sweeper software (V3.20) supports controlling the 'control port' pins by allowing a line in the setup file of the form:

lpt_control_byte=

and switching the control pins of the printer port (1, 14, 16 and 17) accordingly. The setup file 'VHF.SET' that comes with the latest version of the software has been configured to drive the unit in the VHF extended mode, in addition to the usual baseband operation.

If the unit is driven as a spot frequency generator, using the 'YAPLLV.EXE' program, the necessary control pin is driven by the 'HW_switch()' function

— but notice that some bits are actually inverted in the LPT hardware. Some bit shuffling is necessary to hide this from the user.

A demo version of the DDS Sweeper software is available for downloading from the EA BBS, which also contains the latest README file for the full version of the YADDS Sweeper. The package includes the new lookup tables required for the HP2835, MC13055 and AD606 IC detectors as well. To download the package, look for 'DDSWEEP1.ZIP'. However, to run the PLL extensions, the full version of the program will be required. It comes complete with the latest calibration files and the 'VHF.SET' and 'UHF.SET' setup files to drive the PLL/DDS sweeper setup as described.

Application examples

One of the new commands in the setup file for the YADDS Sweeper is

the 'BW_min=' line. If this command is used, the minimum of the displayed resonance peak is measured, and 'L' is calculated that resonates with Cpar at this frequency. This feature is useful for measuring very small inductors, typical in building VHF equipment.

There is no need for a special inductance measurement jig — the series LC circuit can be soldered with short leads 'in the air' across the detector input, to minimise parasitic lead inductance. For example, Fig.20 shows a captured screen measuring a small four-turn coil resonating with a 27pF capacitor.

Another new feature of the Sweeper software is the ability to display the 'Y' axis calibrated directly in Volts (as you will recall, the MAX191 ADC actually measures voltages from 0 to 4.095V with a resolution of 1mV).

A typical 'hissy' sound of an FM demodulator is often caused by a non-linearity in the frequency to voltage

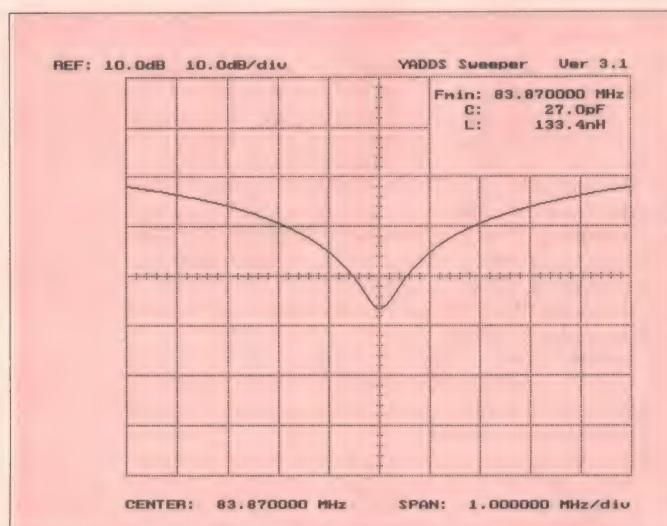


Fig.20: Measuring very small inductors using a series LC circuit — here at 83.87MHz.

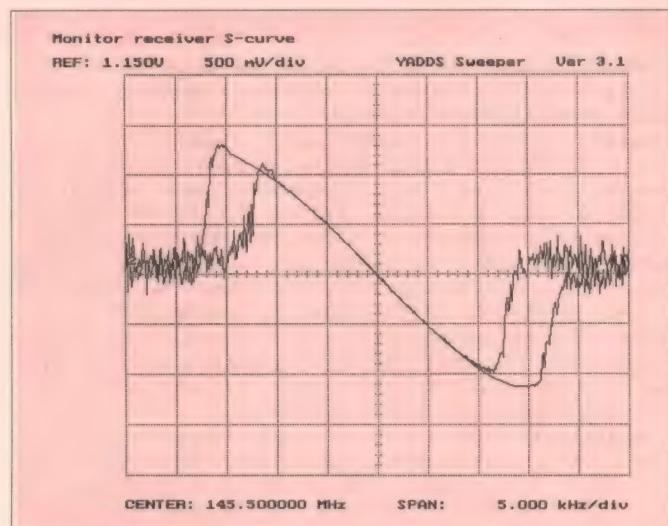


Fig.21: Calibrating an FM receiver S-curve for various signal levels.

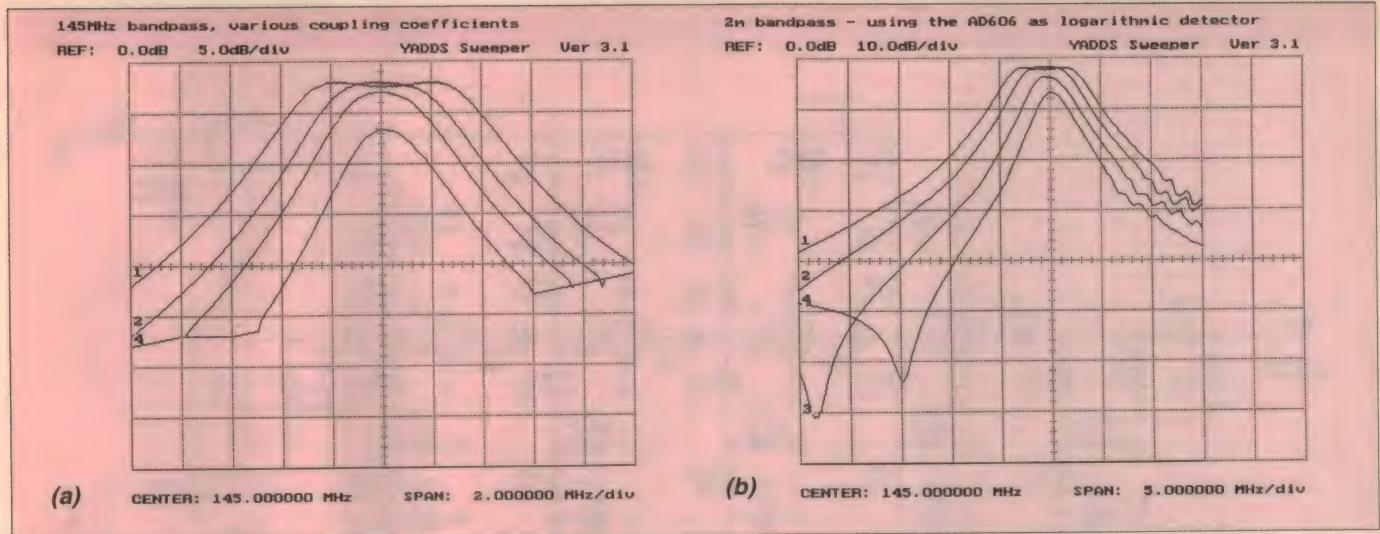


Fig.22 (above): The characteristic of a 2m bandpass filter, measured (a) using the MC13055 as detector and (b) using an AD606 logarithmic detector.

conversion stage. As an example of using the voltage calibrated 'Y' axis, Fig.21 shows the screen capture measuring the S-curve of the authors's test FM receiver. Obviously for deviations more than +/-5kHz there will be significant nonlinearity in the demodulation. But as you can also see, there is no DC shift apparent for increasing the signal level — which is an indication of good AM supression (some other FM demodulators however may give you a small surprise here!).

As the input of the ADC has to be connected directly to the demodulated output of the FM IF chip for this measurement, the unit has to be opened and a shielded lead connected to the ADC input terminals on the LogDet board. Alternatively, an additional BNC input can be fitted to the case for 'External DC' measurements. In this way, using the 'ADC.EXE' program, the unit can be operated as a PC controlled digital voltmeter, with a full scale of 4.095V and 1mV resolution!

Fig.22(a) shows the swept response of a two-metre two section LC bandpass filter, using an MC13055 as the detector stage. As you can see, the coupling coefficient can be optimised to set the required passband — not an easy task without the real time display of the swept frequency response. Only about 25dB range is available at 145MHz, but the display is still quite usable. More range (around 10dB) would be available using the suggested diode detector.

Fig.22(b) shows the response of the same bandpass filter, this time using an AD606 as the logarithmic detector. Note that because of the much improved dynamic range, the notches in the response at around 120MHz are now clearly visible.

Fig.23(a) shows the response obtained sweeping a 303.8MHz SAW resonator in the VHF 'x2' mode, using the diode detector. Notice that even though the doubler itself reduces the useful RF output by about 12dB, and the SAW filter insertion loss is 9dB, there is still some useful display range.

The addition of a 20dB wideband gain block in front of the detector brings out the fine details of the response. Fig.23(b) shows the response obtained sweeping the same SAW resonator, this time with a Mini-Circuits ZFL500-HLN 20dB amplifier connected between the resonator and detector. (The ZFL500-HLN is available from Mini-Circuits distributor Clarke & Severn Electronics.)

A low cost version of a 20dB gain block can also be made up using the NEC gain blocks (uPC1651 or the newer

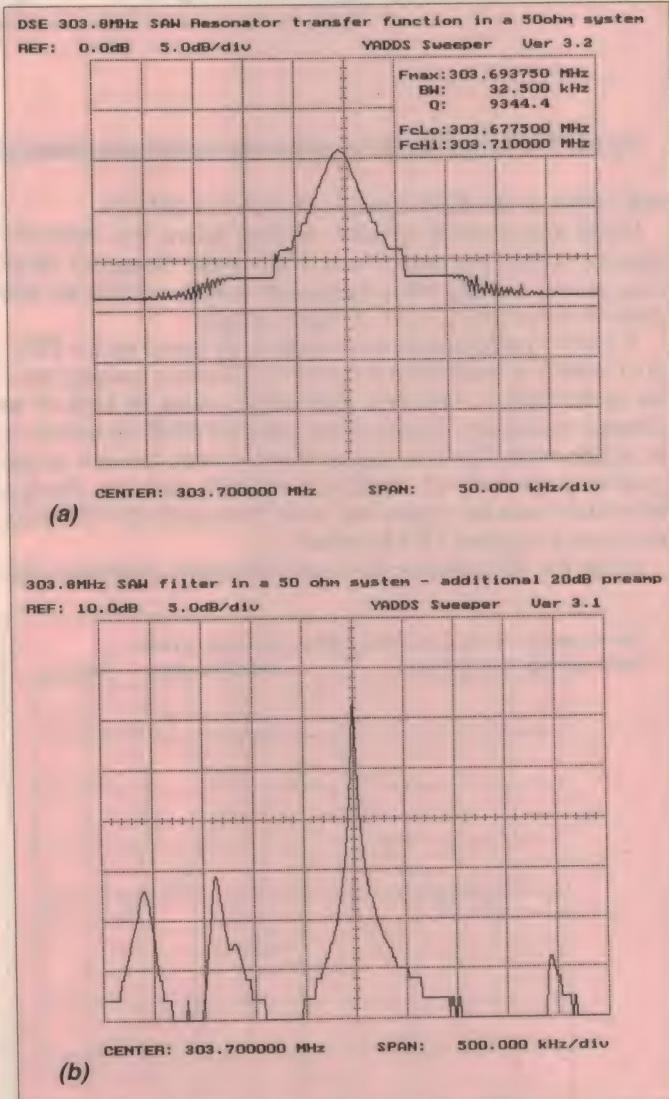


Fig.23: Using the external 'X2' doubler, there is still enough dynamic range with a passive two-diode detector to display the transfer function of circuits with 10dB loss, without additional gain stages (a). The insertion loss of the SAW filter is 9dB. The fine details in the response can be displayed using a 20dB gain block (b).

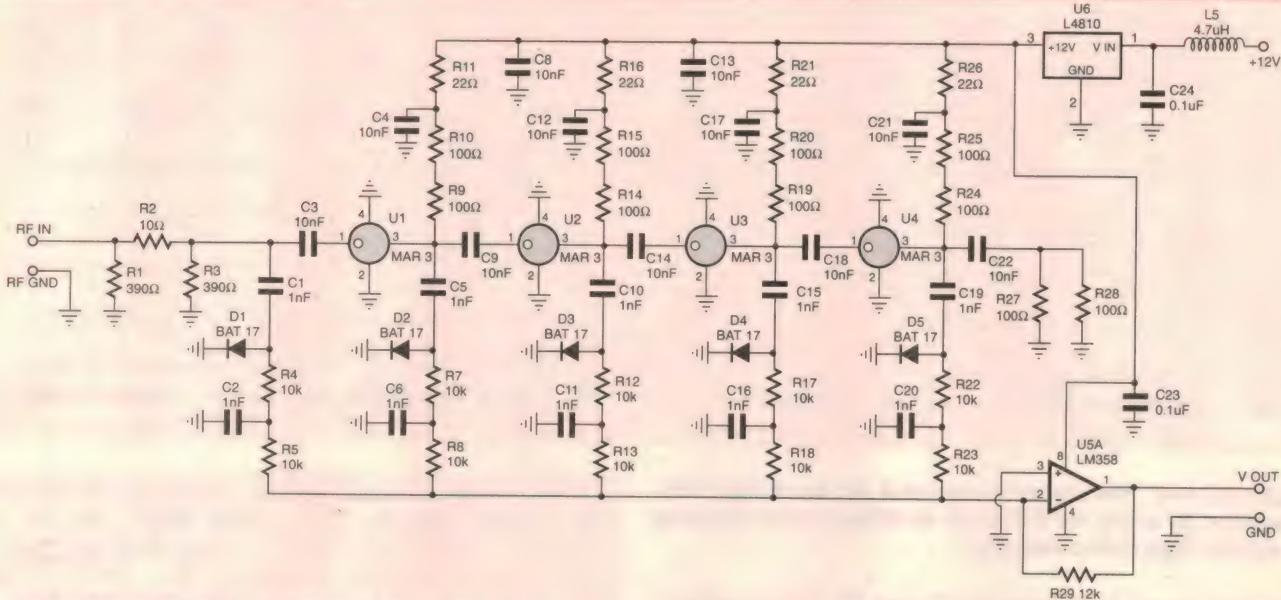


Fig.24: The schematic for a wideband logarithmic detector using a successive detector arrangement of MAR-3 devices.

uPC1688), or the Mini-Circuits MAR series MMICs.

Using a directional coupler, antenna return loss measurements can now be made over a much wider frequency range than before. A ready-made directional coupler suitable for this purpose is the ZFDC-10-1 of Mini-Circuits.

A similar performance unit can be built based on the PDC-10-1, which is a directional coupler built into a housing similar to the SBL-1. However lead lengths must be kept to an absolute minimum (<3mm) if the specified 40dB directivity is to be achieved. The best approach is to mount the unit on the ground plane side of double-sided PCB and use 50-ohm microstrip lines for connection to the three ports (0.105" wide tracks on a standard FR4 laminate).

Using the RF Sweeper as a spot frequency generator, fre-

quencies with better than 50Hz resolution can be generated in the 65 - 160MHz range using the demo 'YAPLLV.EXE' driver. As the source listing is available, any new ideas (scanning, memories, TX/RX offset switch, etc.) can easily be added. The original frequency doubler circuit is still on the revised attenuator PCB, and the frequency of the VHF module can be easily doubled to provide usable signals in the 130 - 320MHz range.

Going even higher

If a YAPLL-U module is fitted instead of the YAPLL-V, UHF frequencies can be covered as well. For example, a YAPLL-U with a POS-535 fitted will cover the 300 - 525MHz frequency range. In this case, however, the front panel attenuator PCB is not usable anymore; either a relay attenuator has to be built, or the RF output of the YAPLL-U module must be connected directly to the 'generator output' BNC to allow external fully calibrated BNC attenuators to be used.

The diode detector works perfectly at these UHF frequencies, providing around 40dB dynamic range (+10dBm generator output, -30dBm lowest indication).

More dynamic range can be obtained using detector circuits with gain. Fig.24 shows such a circuit: four Mini Circuits MAR-3 MMICs, each followed by a diode detector, provide around 60dB of usable dynamic range in a 'successive detector' arrangement. The frequency response of this circuit is not as flat as the diode detector, and the indication will depend on the required lookup table for this circuit individually, for each unit built. The frequency response of the attenuator PCB (Fig.14) was in fact obtained using this detector.

As an example of the UHF extension to the Sweeper, the swept response of a three-section 477MHz helical filter is shown in Fig.25, using the wideband MAR-3/diode detector stage of Fig.24. Clearly there is enough dynamic range for fairly useful measurements.

That's it for the present. But sometime soon, if there's enough interest, I may be able to describe a full Spectrum Analyser project based on the RF modules presented to date. ♦

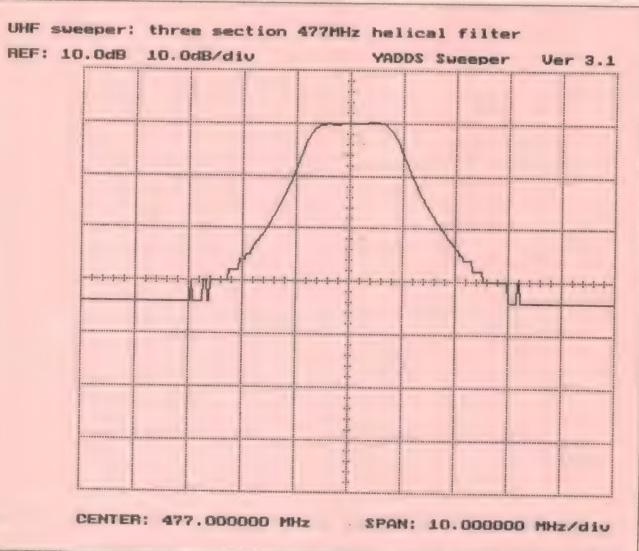


Fig.25: The swept response of a 477MHz helical filter, made using a YAPLL-U module and a MAR-3 wideband log-detector array like that shown in Fig.24.

(Continued from page 27)

combat minimised casualty rates in the UN forces. Its application caused such havoc to targeted Iraqi military systems, formations and equipment that the feared major ground battles, with potentially huge loss of life on both sides, were effectively avoided.

What is now ever more clear is that the outcome of military actions in the future will increasingly be decided by commanders far from the area of physical combat, well supplied with information and intelligence. Accurate and timely data are the life-blood of business, and so it is with the military. Technologically well equipped and trained forces supplied with up-to-date information, able to practice electronic warfare have a distinct edge over their less so-equipped opponents.

It is a sad fact that much of the impetus for the developments which we take for granted in the modern world lies in the need for war-time applications. Nevertheless, the spin-offs of the techniques developed have led to a myriad of improvements to life which we now take for granted — including safer air and sea travel, medical tech-

nology, improved communications, weather forecasting and computers.

And, dare I say, if there is to be another such conflagration between well-armed powers, the use of radio-electronic combat must surely reduce casualties to both the victors and the vanquished.

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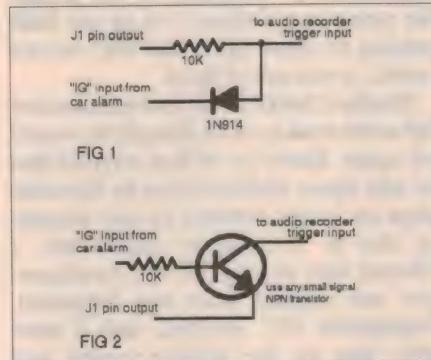
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NOTES & ERRATA

Audible Alarm for Critical Car Systems (March 1987): Author Glenn Pure has advised that a change is needed in the interfacing of the project with the solid state audio recorder (EA February 1995) — for those who want to try this option. If the interface described in the original article is used, engine warnings like low oil pressure will play as soon as the vehicle's ignition is turned off, since the audio recorder can not sense the status of the car's ignition.

This can be rectified in two ways. The simplest way is to power the audio recorder only when the ignition is on. This means the audio recorder can't be used to warn if the headlights are left on when the ignition is switched off, but the piezo in the original project can still be used for this. To ensure the piezo only sounds for the headlight warning, D1 and D2 should be removed from the car alarm circuit and pins 8 and 9 on U2 connected together.

If the audio recorder is to be used for the 'headlights on' warning as well as the engine warnings, it has to be powered even when the ignition is off. A few



extra components must also be inserted between the car alarm and the audio recorder trigger inputs. Note that you must use J1 pins 5 to 8 on the car alarm for the interface. Do not attempt to use pins 1 to 4 of J1.

For J1 pins on the car alarm that go high (to +12V) when a fault condition is detected (this is the more common case), use the circuit in Fig.1. Note that you will also have to take the signal from the 'IG' input on the car alarm board.

For J1 pins that go low on a fault occurring, use the circuit in Fig.2. These simple circuits can be assembled on a small piece of matrix board. ♦

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INFORMATION CENTRE

by PETER PHILLIPS

Computer gripes, circuits, valve amps & more

This month we look at a number of circuits and answer quite a range of enquiries. There's discussion on adding earphones to a power amplifier, using a TV set as a computer monitor, and I start the column with a criticism of the computer industry.

The electronics industry in Australia today is largely focused on communications, as this is one of the growth industries in almost every part of the world. But to many people, computers are the mainstay of the electronics industry. And for good reason — there's now at least one computer shop in most towns or suburbs, and major companies such as IBM have set up manufacturing plants in Australia to feed the almost insatiable demand.

But is this industry really serving our needs? I'm presenting a number of true stories that, to me, indicate that the computer industry seems either not to care about customers, or is just not able to meet customer demands.

The first concerns an IBM Aptiva computer, which I wrote about some time ago. It belongs to a friend who has little computer experience. He purchased it about 12 months ago and has used it extensively ever since. He went for the IBM brand in the belief that 'Big Blue' must make a better product.

A few weeks ago its hard disk died, so my friend lumped the system back to an IBM repair centre. He was told that virtually all Aptiva computers were experiencing the same thing, caused by faulty bearings in the drive. No problem, said the technician, we'll replace it free of charge. The only problem was, this would restore the system to how it was when shipped. All work on the old drive would be lost — a year's work.

Because the old drive merely needed a 'hit with a screwdriver' to make it run, I suggested my friend ask the service centre to copy the contents of the old drive to the new, so he would not be back to square one. After all, installing software, drivers and so on is a time consuming task, especially for a novice. He was advised that, although possible, it could not be done by the service centre due to the way jobs are allocated. In other words, all the IBM centre could do was replace the drive and undo every-

thing that had been done on the system since its original installation. Anything further was up to the owner...

A computer expert might be able to cope with this, through backups and so on, but not the average user, who simply regards a computer as a tool. Computers are heavily advertised, with the suggestion that computers will do all sorts of amazing things, that they are easy to use and so on. It's just not true!

The second story is about an IPC laptop, model P5. IPC came on the scene a few years ago, opening a number of retail outlets and selling its own brand of desktop and laptop computers. Another friend of mine bought a P5 laptop, paying extra for an on-site five year warranty. Unfortunately the computer had an intermittent fault that regularly stopped it from booting. He had it back for repair many times, but as the fault refused to show up at the IPC service centre, it was never fixed.

Finally it broke down and remained so for some weeks, so he thought he would try again. However he was advised that he and about 10,000 others in Australia were no longer covered by any warranty, due to 'a company restructure'. I advised him to ring the IPC headquarters and explain what had happened. Fortunately IPC listened, and I went with him to the service centre and explained the history, suggesting it needed a new motherboard. Fortunately the fault showed up, the motherboard was replaced and the P5 is now working. But what if someone like me had not helped this guy? More land fill to the local tip, perhaps.

And then there's the story about my ill-fated Toshiba system, all due to what appears to have been a faulty docking station. It took weeks before the station was replaced, and I had to fight all the way. My fault, they said! There were also other problems, which I documented in the November and December '96 issues.

But it doesn't stop there; what about software? I'm convinced that software only becomes popular if it's marketed well, regardless of how good or bad the software really is. Remember the DOS version of Wordperfect? Surely no wordprocessor was more difficult to use, and yet it became a standard, because it was marketed well and was offered with training. It certainly *needed* extensive training to use, and the world ignored much easier word-processors such as Wordstar 2000 — probably just because they weren't marketed as aggressively.

Today the popular wordprocessor is Word for Windows. I'm bound to get a few arguments when I say Word 6.0 is slow, difficult to use, lacks many features and is unreliable. But the might of Microsoft marketing makes it the standard. Personally I prefer AmiPro, and have used it to produce text books, large and small documents and all sorts of work that often cannot be done in Word 6.0. But because I do a lot of desktop publishing for industry (between magazine work), I'm obliged to use Word 6.0 on occasion, in lieu of AmiPro.

I recently found I could not make a section of a Word 6.0 document stay in the place I wanted it, and after spending too much time on it, I contacted Microsoft. Although I'm a Communique member, it was still going to cost me \$30 for someone to help me. I insisted I knew what I was doing, and that it was a bug. But no go, so as I refused to pay, I had to solve the problem myself. I recreated the section using another technique, and eventually got around the problem. Other companies offer free support but, it seems, not Microsoft the industry giant.

There are lots of other stories, but my point is the computer industry has a long way to go before the average person can buy a computer and get the support such a complex device needs. Until the industry gets its act together, people are going

to experience the sort of things I've just described, writing their losses off as a learning experience.

It would be interesting to add up all the lost time people have had with badly supported systems. I reckon it would amount to millions of dollars. Yet who's making the money? Not the poor old user! You either learn to fix it yourself, become a bully, or waste your money. I welcome your comments.

Now that I've said all that, in the hope it might make some people stand up for their rights, we'll move on to our first letter — which coincidentally, concerns computers.

TV as a computer monitor

This letter is about adapting a conventional TV set as an IBM computer monitor. Perhaps we have an answer...

I have a redundant PC with a faulty non-standard video display that is beyond economical repair. For some time I have been toying with the idea of building an interface to provide a lower resolution monitor using the AV socket of a modern TV set. Ideally it would be a plug-in PCB with an external RCA connector and some means of selecting the video mode.

There is a commercial unit available, but it is priced at over NZ \$300. I was hoping for something a bit cheaper. Has EA ever published anything along these lines, or if not are you likely to? I assume the current trend for high resolution makes this unlikely, but something able to display text would be useful, and would allow a number of people to view the same display together. (Roger Duke, Christchurch, NZ)

Roger, it's possible that a unit I designed and described in the February 1989 issue might help you. This device accepts a CGA output

(remember that mode?) and converts it to analog RGB signals.

At the time I had an Apple RGB colour monitor, and I designed this adaptor so I could use the monitor with my '286 IBM compatible, mainly to get colour. It worked well, and because the CGA standard uses scan frequencies of 15.75kHz and 60Hz, the adaptor can be used with most colour TV sets. It doesn't have a composite video output, but a simple video mixer would fix that. Or you could adapt a TV set and add an RGB input. I did this after the article was published on a Pye T26, giving me a 22" (55cm) colour computer monitor way back in 1989.

Of course you'll need a CGA video card, which you might pick up from a computer supplier. The software will need to run with CGA, and I guess you'll therefore be stuck with relatively old DOS-based programs. The article I wrote about the adaptor gives a brief explanation on how to adapt a conventional TV set.

Magnetic airship

It seems not everyone likes to read about the bizarre:

In the February issue you included an article about an 'anti-gravity airship'. You concluded it was in fact a magnetic airship and agreed with the author that the said vehicle could fly into space.

All the sums involved in the article were obviously made for sea level. Surely when the craft obtained high altitude, the rarefied air would cause the thing to explode, if there was not a reduction in the pressure of the helium which gives the machine most of its lift at sea level.

As the 'spaceship' rises, the lift due to the helium gas would be greatly reduced due to the lack of atmosphere up there.

This would leave only the rather weak influence of the magnetic field to take the contraption any higher. It would be akin to trying to fly a submarine using its propellers.

We have quite a few magazines devoted to unusual or bizarre machines and incidents. Couldn't we keep good old Electronics Australia straight! (Brian Robb, Alstonville, NSW)

First up Brian, I did not agree the airship could fly into space. In fact, my only conclusion was that it appeared to work against the Earth's magnetic field, not anti-gravity. I included the description on the basis that it could in fact be built, making it real, not bizarre. Of course it's a pretty strange device, and it's unlikely anyone would build it, but then you never know. As well, if we only ever stick to the mundane, we'll get letters saying we have become boring! Still, I take your point.

High current regulator

Boosting the current capacity of a three-terminal voltage regulator circuit is relatively common practice, by using a PNP series pass transistor with the regulator. But what if you don't want to use a PNP device, like our next correspondent?

Could you please enlighten me. I am endeavouring to increase the current output for some 7805 and 7812 three-terminal voltage regulators to about 5A, using a series pass transistor.

I remember reading somewhere that an NPN transistor could be used for this purpose, instead of the more common method of using a PNP transistor like an MJ2955. Why, you might ask? You see, I have oodles of 2N3055s in my junk box, just dying to be used. Therefore I'm anxious to find a way and to save some dollars. Could you please advise if this is possible, and perhaps provide a circuit. I'm only an mechanical engineer! (Tyrone Smith, Rankin Park NSW)

I looked through a number of books Tyrone, and only found one that gives a possible circuit, shown in Fig.1. This circuit comes from the book *Understanding DC Power Supplies* by Barry Davis, published 1981. It's an Australian book, so it's likely to be in most technical libraries.

I haven't built this circuit, so I can't guarantee its performance. Basically, the ratio of regulator current to transistor current is set by resistors R1 and R2. So if you want say a current of 500mA to flow through the regulator and a transistor current of 4.5A (for a total of 5A), R2 needs to be nine times the value of R1. Of course, R1 should be a relatively low

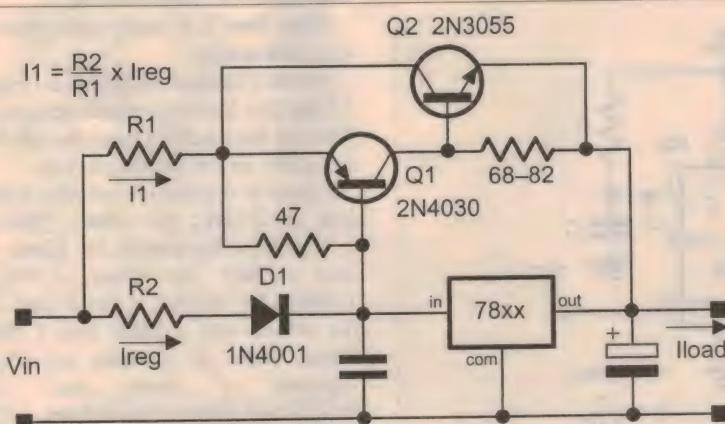


Fig.1: Using an NPN power transistor to boost the current capability of a three-terminal regulator.

value, as the voltage drop across it and the heat it generates need to be kept to a minimum. I suggest a value of 0.47Ω , which gives a value of around 4.2Ω for R_2 .

Ideally, you should mount the regulator and Q_2 on the same heatsink to keep the junction to ambient temperatures the same. According to Davis, this will extend the thermal protection of the regulator to the transistors. You might need to fiddle with some of the resistor values, and to find an equivalent for a 2N4030. I'd try a BD140.

Power amplifiers

The next letter has a number of questions, mainly about power amplifiers:

I am writing to find out about power supplies. I have found two power amplifier projects I would like to build, as soon as I can find appropriate parts, but the power supplies for them are nominally 115V AC, 60Hz. Can I substitute the specified 110 volt transformer for a 240 volt equivalent? One transformer is a 130VA, 110V 22-0-22V. The bridge rectifier is 4A 200V, and each rail has 20,000uF of filter capacitance. I can't see why it isn't possible to use an appropriate 240V transformer, but I thought I'd ask first.

Another question: do you know of any books on designing class A amplifiers? I thought I read a review of one in a

British hifi magazine that covered both valve and solid state.

Also when I build the integrated amplifier that I am currently working on, I would like to put a headphone socket in it. I don't want a separate headphone amplifier, and would like to know if there is an easy way to work out what resistance is needed between the amplifier and the socket.

Incidentally are there any audio clubs or societies in Tasmania that you know of, particularly in the Launceston area, and especially on DIY audio? (Leigh Witchard, Prospect, Tas)

Looking at your first question Leigh, you can most certainly use a 240V, 130VA 20-0-20V transformer. The only thing to watch with any transformer is its VA rating, assuming it has the secondary voltages you need. The difference between a 110V and 240V transformer is simply the turns ratio.

I am not aware of any books that deal with class A amplifier design (except some very old ones). But that's not say they aren't around. Perhaps a reader might know of one.

Regarding a headphone socket, because today's headphones are so efficient you certainly need a resistor between the socket terminals and the speaker terminals, to prevent damage to your ears and the headphones. I can't be exact, as it

depends on the headphones, but a typical power rating for modern 32 ohm headphones is around 50mW. To work out the value of a suitable series resistor, I suggest you go about it like this:

(1) Determine the maximum RMS output voltage of the amplifier by finding the square root of the product of the maximum output power and the speaker resistance for this output power. For example, if the amplifier is rated at 100W into a 4W load, the maximum output voltage is 20V RMS.

(2) Now figure out the RMS voltage to drive the headphones. To do this, find the square root of the product of the power rating and the resistance of the headphones. For 32Ω 50mW headphones, this works out at 1.27V RMS.

(3) Now subtract (2) from (1), to find the voltage drop across the unknown series resistor R_x , which for this example is 18.73V RMS. The ratio of the two resistors (R_x and Rheadphone) is the same as the voltage ratio, so R_x is the resistance of the headphones multiplied by the voltage across R_x divided by the voltage across the headphones. That is, around 470Ω for this example. (See Fig.2.)

(4) The power rating of R_x is the square of the voltage across it, divided by its resistance ($= 350.8/470$), which gives 0.75W. So for this example, use a 470Ω 1W resistor (one per channel).

Modern amplifiers usually have a muting relay to switch the speakers. You might be able to switch this relay through the headphone cutout contacts. Or for an amplifier with a power output of say 40W or less, you can switch the speakers directly through the socket.

Complex oscillator

Now here's a curly one, from a 13 year old reader:

I need a hand in designing a circuit. I'm 13 and just learning about oscillators. The Funway books don't have the information I'm after, so I'm writing to you.

I want to build a circuit that will oscillate at 2.6kHz for 60ms, 700Hz and 1.7kHz simultaneously for 60ms, 900Hz and 1.7kHz for 60ms, 1.1kHz and 1.7kHz for 100ms, 1.3kHz and 1.7kHz for 60ms, and 1.5kHz and 1.7kHz for 60ms. How do I make an oscillator capable of doing this? (Stuart MacIntosh, North Canterbury, NZ)

You haven't told me, Stuart, what sort of waveform you want from the oscillator. But if we assume a square wave, you can use the good old 555 timer.

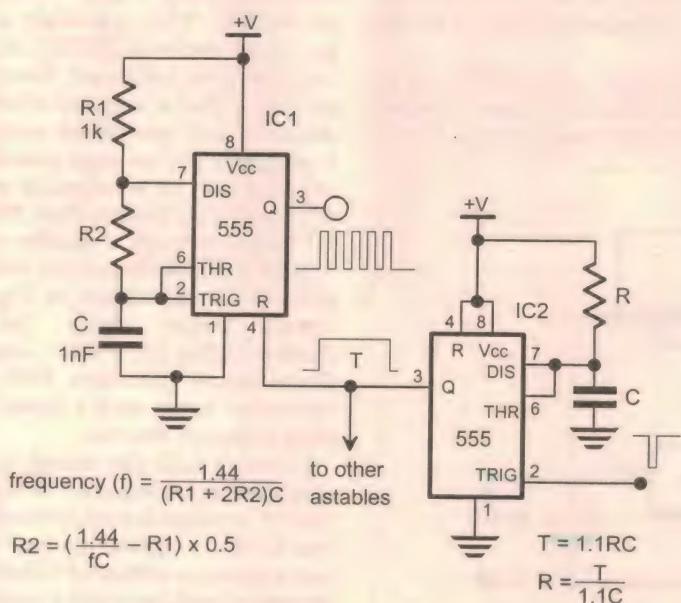


Fig.3: IC1 is an astable that runs during the timing cycle of IC2, which is connected as a monostable.

Like most things in electronics, there are many ways of doing this, but we'll stick to something simple, even though it might not be the most efficient way.

First you'll need seven 555 timers connected as astable oscillators to give the seven frequencies you want. Next you'll need a circuit to switch these on and off. I'm not sure whether you want a sequence, or simply your specified outputs for 60ms. If you only want each oscillator to run for 60ms, you can use one 555 connected as a monostable with a timeout of 60ms. So that makes eight 555 timers and their associated components. Now to some circuitry:

I've shown the basic idea in Fig.3. The circuit around IC1 is a 555 astable. Make $R_1 = 1k$, $C = 1nF$ and calculate R_2 as per the equation in Fig 3. For a frequency of 2.6kHz, R_2 calculates to 276423 ohm, or 270k. I'll leave you to work out the value of R_2 for the other frequencies you want. Incidentally, the reason for making R_1 a 1k resistor is to make the duty cycle of the waveform equal. The minimum value for R_1 is specified for a 555 as 1k.

The monostable is based around IC2, and its output connects to the reset input of IC1. So when the output of IC2 is high (which it is during its timing period), it will enable IC1 (and any other astable it's connected to), allowing IC1 to run for the timeout period of IC2. Because you want this to be 60ms, pick a value for C and calculate R. For instance if C is 0.1uF, R is 5454545 ohm, or 560k.

Naturally you'll need to fine tune the component values, perhaps by adding a variable resistor and adjusting it until the frequencies or the timing period are correct. Good luck.

Variable speed CDP

I recently noticed a short review of a Denon DCD-815 CD player in the *SMH TV guide*, March 3-9, 1997. It has a price tag of \$599 — but guess what, it's also got a pitch control and an adjustable playback speed. So given the number of requests I've had for such a player, I thought I'd pass this information on. For more information, contact AWA Distribution; phone (02) 9898 7666.

Beta VCR

Our next correspondent wants to know about converting a Beta VCR to PAL, and about valve power amplifier circuits:

I am writing to find out if a Beta VCR can be converted to run PAL. The machine is in good working order, but I believe Beta type tapes are no longer available? Could you please advise me.

Also do you know of any information

$$Rx = 32 \times \frac{18.73}{1.27}$$

$$Rx = 471 \text{ ohm}$$

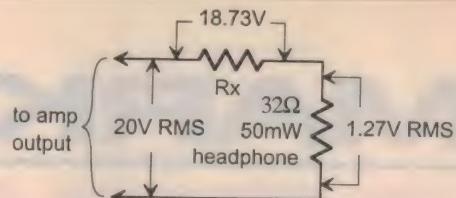


Fig.2: Calculating the series resistance for headphones connected to a power amplifier.

that describes valve power amplifier circuits? No one I've asked seems to be able to help. I am interested in such a circuit using a pair of 807s for the output stage.

With regard to the query about NTSC-PAL video in the December '95 issue, on a recent tour of the ABC studios in Adelaide, I noticed a fairly large machine that had provision for NTSC and PAL tapes. This machine could undoubtedly be used for converting between the two systems.

I enjoy reading your Information Centre each month, in fact the whole magazine is fantastically interesting. (Michael Gell, Glenelg, SA)

Thanks for the kind comments, Michael. I assume the Beta machine you're referring to is NTSC. There's no easy way of making it a PAL machine, but some modern TV sets will work with an NTSC format, as well as PAL. You're right about the general unavailability of Beta tapes, although I suspect videos are still available from specialist outlets. When I'm next on the Web, I'll see what I can find.

The only book I can find that might help you in regard to valve power amplifier design is the venerable *Radiotron Designers Handbook*. I have the fourth edition, and there's a circuit of a class AB2 output stage that uses 807s on page 593, along with a description. It might help you. The problem you'll be faced with is getting suitable transformers, although the general resurgence of interest in valve amplifiers is seeing a revival of valve and transformer manufacturing. Unfortunately, I think most of the suppliers are overseas. Perhaps a reader might know more.

What??

Following our earlier discussion on headphones, this question seems rather appropriate. It was sent by Richard Stone, via our BBS, but unfortunately without a solution. I've tried to contact Richard, but as he's unavailable, I've worked out what I think is a reasonable answer. Perhaps when you read this Richard, you might let me know if my answer agrees with yours. Here's the question, which only needs

basic theory to solve:

In earlier times the headphones used on hifi systems were relatively inefficient and had an impedance of 8Ω . Nowadays they are much more efficient and generally have an impedance of 32Ω . Having just repaired an elderly amplifier, rather than test it with a set of speakers, I plugged in a pair of modern earphones via a 6.35mm to 3.5mm adaptor. Goodbye earphones!

The headphone socket has 220-ohm one watt resistors in series with the main amplifier speaker outputs, which might have been suitable for older headphones, but certainly not for modern ones. So I sat down and worked out the correct resistor to do the job for 32Ω . I then decided to work out the best possible combination of resistors so 8Ω or 32Ω headphones will both get the same power. This turned out to be quite a challenge! So my question is:

If you have an audio amplifier putting out 20V RMS, what is the best possible combination of two resistors (R_1 in series from the output, R_2 in parallel with the headphone) such that the power supplied to either an 8Ω or 32Ω headphone is 40mW, +/-1mW?

Answer to April's What!?

The answer is seven. First customer takes half of the seven transistors (3 1/2), plus a half, or a total of four transistors. Get it? Customer two takes two transistors, leaving one for customer three. Now you can also see why none of the transistors needed to be cut in half. ♦

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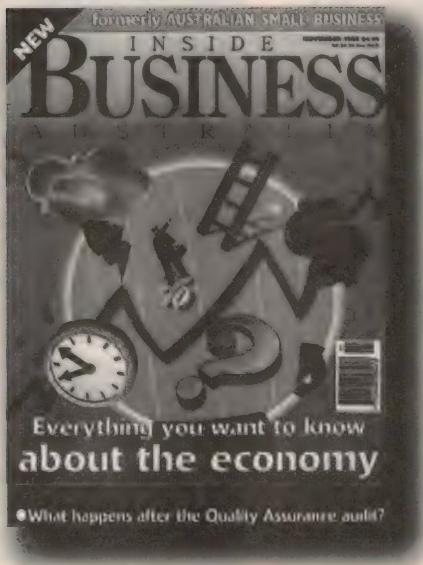
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50 and 25 years ago...

'Electronics Australia' is one of the longest running technical publications in the world. We started as 'Wireless Weekly' in August 1922 and became 'Radio and Hobbies in Australia' in April 1939. The title was changed to 'Radio, Television and Hobbies' in February 1955 and finally, to 'Electronics Australia' in April 1965. Here we feature some items from past issues.

May 1947

Colour Television — New Electronic Method: Electronic colour television pictures, produced by all-electronic means, have been developed by Radio Corporation of America at RCA Laboratories in Princeton, NJ. A demonstration, revealing a revolutionary development in radio science, proved that flickerless, all electronic colour television is practical without rotating discs or other moving parts. It was further disclosed that a simple, inexpensive radio frequency converter makes it possible to introduce this all-electronic colour TV system without causing obsolescence of black-and-white receivers.

The receiving set is equipped with three 3-inch kinescopes, which separate-

ly receive the signals representing red, blue and green. This trio of kinescopes is called a trinescope. From it the three colour images are optically projected into a brilliant composite picture which appears on a 15 x 20-inch screen in natural colour, free from any flicker, colour fringes or break-up of colour.

May 1972

Flying Atomic Clock Experiment supports Einstein's Theory: Time dilation — the special part of Einstein's relativity theory that predicts more time will pass for stay-at-homes than for fast-moving space travellers returning to earth, underwent a new test recently; also tested by the experiment was the interaction of gravity and time, a part of the General Theory. It was the first

known experimental demonstration of these effects, using actual time-recording clocks, and the preliminary results seem to support Einstein.

Professor Joseph C. Hafele of Washington University, St Louis Missouri, and Richard Keating of the US Naval Observatory, Washington DC, flew a set of four Hewlett-Packard precision atomic clocks around the world. They flew the route once eastward and once westward, measuring how much time the clocks recorded during their trips, relative to the time observed on earth by the ensemble of Hewlett-Packard atomic clocks at the Naval Observatory — which are the United States' official timekeeper. The experiment was funded by the Observatory.

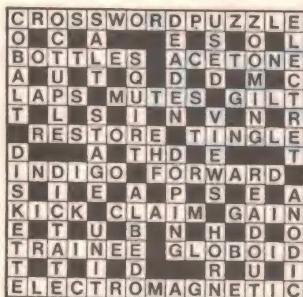
The expected results depend on the actual paths, velocities and altitudes during the flights. For a total flight time of about 38 hours at 650 miles per hour, at an altitude of 35,000 feet around the equator, the predicted results are a loss for the eastward flight of about 110 nanoseconds relative to the clocks on earth, and a gain of about 300ns for the westward flight. Preliminary uncorrected results indicate a slight loss for the eastward trip and a definite gain for the westward trip. ♦

EA CROSSWORD

ACROSS

- Geophysicists study such waves. (7)
- Monitoring device. (7)
- Hearing apparatus. (9)
- Maintains security, settings, etc. (5)
- Conductor in certain transport systems. (4)
- Rate of rhythm. (5)
- Reverse of Hall effect, the ... effect. (4)
- Incoming signal. (5)

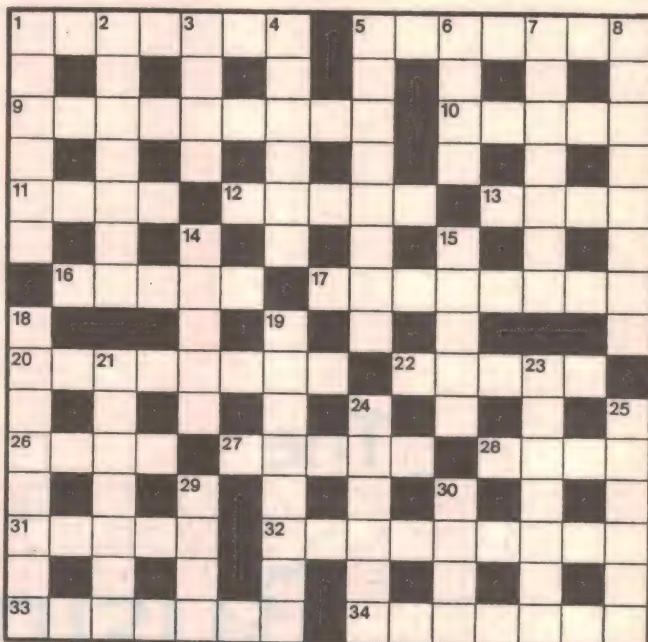
SOLUTION TO APRIL 1997:



- Components of a numbering system. (8)
- Said of systems operating with minimum delay. (4-4)
- Queen of the sciences (abbr.). (5)
- Bearing of 90°. (4)
- Tertiary teacher. (5)
- Said of paired arrangement. (4)
- Cutting instrument, the thermal (5)
- Interact destructively with another signal. (9)
- Repair a fault. (7)
- Removes an item. (7)

DOWN

- Symmetrical solid. (6)
- Nationality of Galvani. (7)
- Millions of instructions per second. (4)
- Inductors. (6)
- Scanning. (8)
- Fuse. (4)
- Oral lesson. (7)
- Without corrosion. (8)
- Ordered series of instrumental movements. (5)
- Transformation of radioactive element. (5)
- Former brand of TV set. (8)
- Substance used in doping. (8)
- Specific substance used in doping. (7)
- Partner of Packard. (7)
- Put a computer into operational state. (6)
- Registers. (6)
- Metric prefix. (4)
- Voice recording can be history. (4) ♦



Experimenting with Electronics

by DARREN YATES, B.Sc.

Noise Makers — the sequel

This month, we finish off our look at noisemakers with some more unusual circuits that produce noises we know and (sometimes) love. There's an electronic bongo, a gong, a musical doorbell, two different metronomes and a 'waa-waa' sound maker — all very simple, low cost and easy to get going.

As we mentioned last month, circuits that make noise can keep kids entertained for hours; they can also be the cause of extreme tension in adults! Nevertheless, this month we look at some of the more harmonious circuits — which should be useful to anyone with a musical bent.

It's funny, but the average person in the street has very little idea about the electronics behind today's music. The fact that most don't care is beside the point, I feel, as is the fact that a lot of current music does an excellent job of imitating a metronome with a bad case of bass boost!

Whatever the case, electronics and music go hand in hand and have done so from the day Buddy Holly plugged himself into history.

While the circuits we're looking at are definitely 'state of the art', they go to show that you don't need the latest whizz-bang microprocessors to produce some pretty classic sound effects.

Electronic bongos

Our first circuit (Fig.1) imitates the sound of a couple of bongo drums. Again, while it may sound like a difficult task to reproduce this sound electronically, it's not really. When you hit a bongo with your hand, the vibration of the skin sets up a resonant wave inside the hollow surround. This wave dies away quickly, but it's enough for your ears to recognize a musical note. It's actually relatively simple to reproduce this effect electronically; you don't need any fancy components either.

This circuit is not new and, in fact, the first time I saw it was in an old copy of *Project Electronics* which hit the streets in 1977. That circuit was very small and worked well — it's hard to improve it or shrink it any smaller than the two garden-variety transistors...

Our electronic bongo does pretty much the same thing as a real one. You hit two

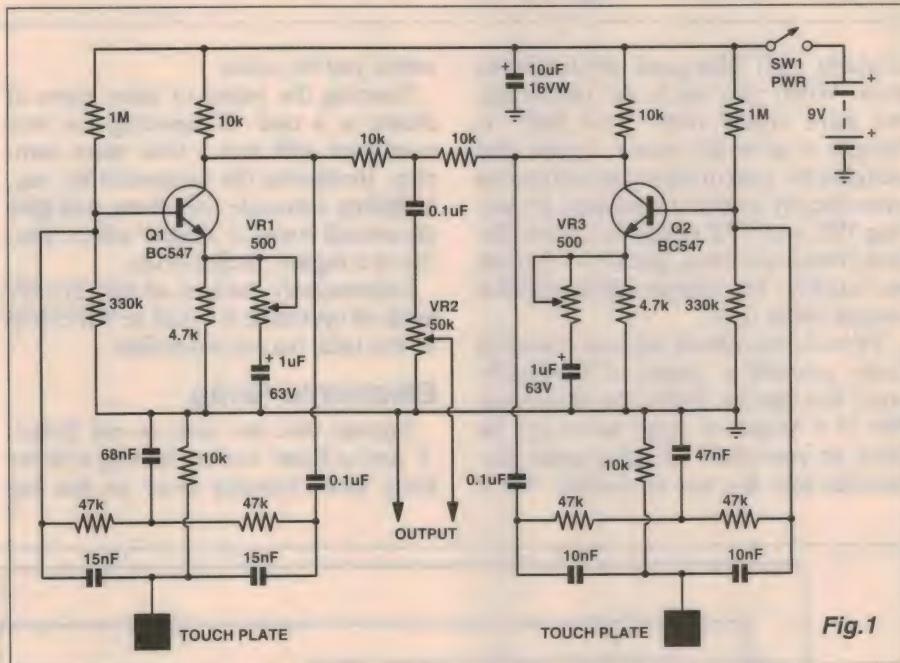


Fig.1

aluminium plates and the circuit produces a fast-dying resonant tone at the output.

Now if you thought that a circuit like this would have to use a couple of sinewave oscillators, then you're right on the money. It uses a type we haven't covered yet, called a twin-T sinewave oscillator. The term 'twin-T' comes from the filter arrangement around each of the transistors. This circuit uses two of them, both set to different frequencies to give a more authentic feel.

If you look carefully at the circuit diagram in Fig.1, you'll see two T-shaped R/C combinations around each of the two transistors. These T-shaped configurations are filters, which allow only a certain range of frequencies from the output to be coupled back to the input.

The idea of the two filters is that one is a high pass filter, the other a low-pass. The trick is that at a certain point along the spectrum, the filters will not attenuate a small range of frequencies. If the gain of

the circuit is greater than one at this point, and the phase shift is right, then the circuit should oscillate at that frequency. The technical term is that we need a high 'Q-factor' for the filter, where Q is a measure of how 'sharply' the filter differentiates between the frequencies it lets through, and those that are attenuated.

(We won't go further on the Q-factor here, as it is normally tackled in second-year electronics courses and is a fairly complex concept. If you want to look at it in greater detail, there are a number of good texts on filters freely available which cover it.)

In this case we don't really want the circuit to oscillate but rather just 'think about it'. To do that we need to adjust the gain of the circuit so that it is a touch less than one. At that point, the circuit won't oscillate by itself but your hand provides the extra 'grunt' to push it into doing so.

The human body is a good receptor of all the junk energy floating around, par-

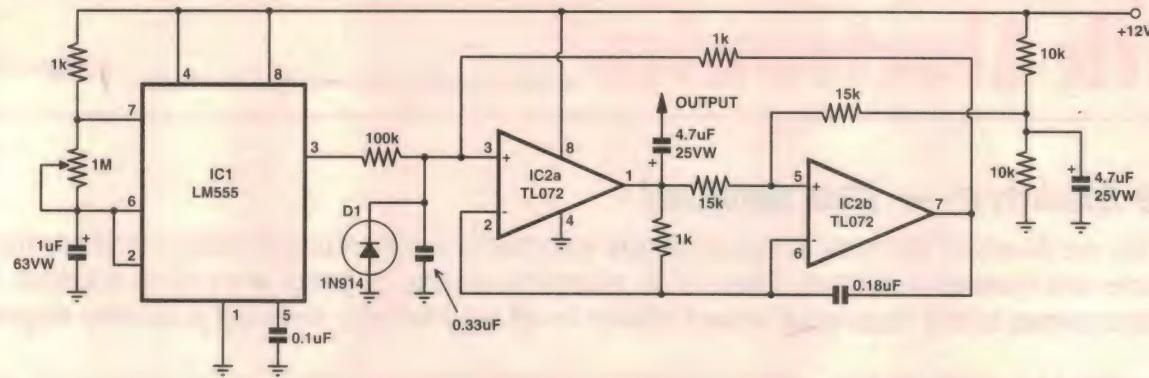


Fig.2

ticularly stuff like good old-fashioned hum. When you touch the touchplate, the hum signal from your body is enough to give the circuit a push, just nudging the gain of the circuit above one momentarily so that it oscillates. By setting VR1 and VR2 precisely, the oscillation should die away quickly — but not too quickly. You simply adjust it until it sounds about right.

To build this circuit up, you'll need to make yourself a couple of reasonably sized touchplates. Either the aluminium lids of a couple of zippy boxes can be used, or you could try using some aluminium foil. It's not as durable, but it

works just the same.

Creating the sound of other types of drums is a case of replacing the sine waveform with one a little more complex. Increasing the harmonics by, say, including a triangle waveform, will give the overall sound a 'tinnier' effect, similar to a higher pitched drum.

Unfortunately, because of this circuit's mode of operation, it would be difficult to do this here; but not impossible.

Electronic Gong

Anyone who has seen an old British 'J. Arthur Rank' movie, starting with the beefy bloke banging away on that big

old gong, knows what it sounds like. I've seen a number of old British movies where this bloke is on, and I'm sure he must be suffering industrial deafness and resting quietly on 'compo' by now...

This next circuit is slightly different and uses a bandpass filter built around IC2a and IC2b. While it may be repetitious to some, it's important to see how different components work in similar roles. Here, we can see how transistors and op-amps work in the role of resonant filters.

The main difference here is that instead of giving it a slight thump, a 555 IC does the thumping for you at regular intervals. This circuit could be used as a

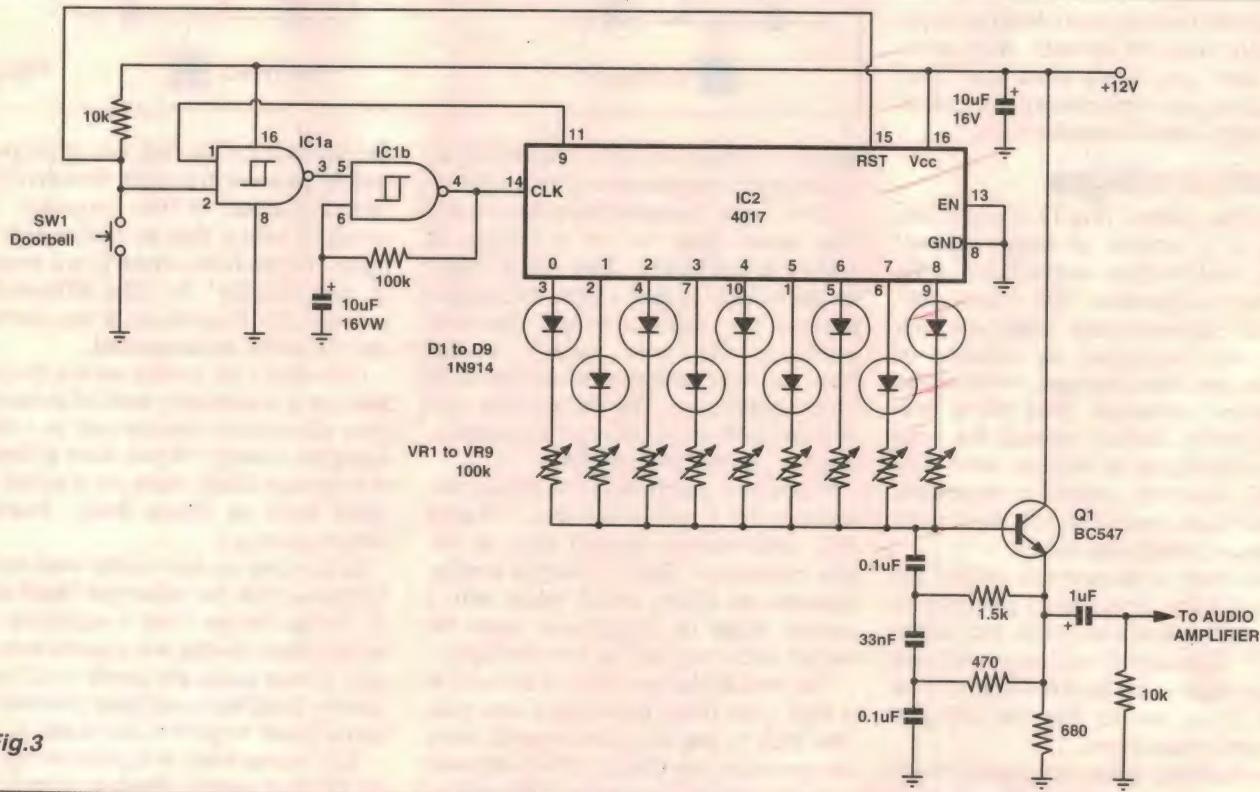


Fig.3

simple drum machine, or for an exotic African clock circuit.

Looking at the circuit in Fig.2, IC1 forms a simple pulse waveform generator. Similarly to the previous circuit, the pulse triggers the resonant filter built around op-amps IC2a and b. The output can then be taken to a power amplifier.

Whereas the previous circuit could be driven into action with a tiny signal from your hands, this circuit does require a short high-voltage pulse and so isn't suitable for basic hand operation unless you add in some extra interface circuitry to do the job.

The interesting point out of all of this is that op-amps don't necessarily make circuit design easier. For mathematical and straight audio work, they're fine — but for radio frequency work and the more unusual circuit designs we've featured over the last year, they're pretty ordinary.

Musical Doorbell

This next circuit actually gets us back on track with our CMOS discussion as well as being a handy — if not kitch — doorbell. It also introduces a new CMOS IC, the 4017 decade counter. This IC is particularly useful and found in many circuits, one of the reasons being its 'ring-of-10' output. By this, I mean that the 4017 has 10 outputs, each of which goes high in turn with the positive-going edge of each new clock cycle.

A couple of months ago, we looked at a shift register made up of 4013 flip-flops. The internals of a 4017, while not being quite the same as our shift register circuit, do a fairly similar job. If we took our shift register circuit and fed the last output back to the input and added a clock signal, we'd get the same result. The beauty of the 4017 is that it's reasonably easy to

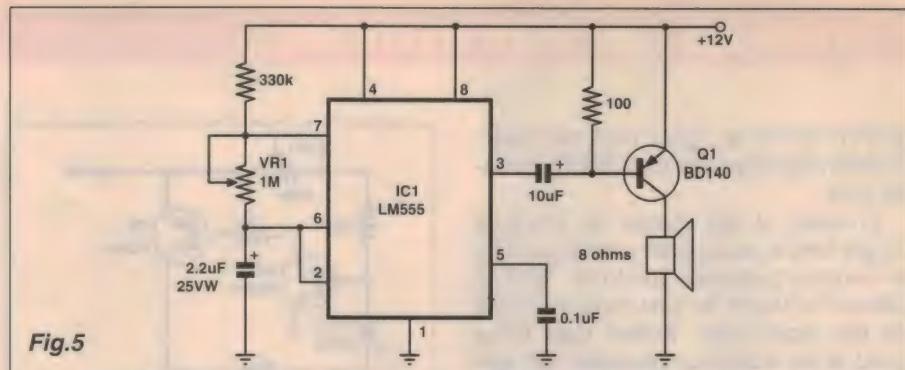


Fig.5

use, you can get it from just about anywhere and they're quite cheap.

Added to its 10 outputs, the 4017 also has a divide-by-10 output which completes one cycle on every 10 input clock cycles. This makes it a very handy little IC, and perfect for our purposes here.

The circuit in Fig.3 is actually a nine-note chime. The tenth output is used to control the clock circuitry, so that it doesn't continue on indefinitely.

When power is applied to the circuit for the first time, IC2 is set so that output Q0 is high and all others are low. Since Q9 (pin 11, shown at the top) is low, IC1a's output goes high. This high allows the clock oscillator around IC1b to start up and send pulses to IC2. IC2 now counts up through its outputs from Q0 to Q9. Once Q9 goes high, the output of IC1a falls low because it now has two high inputs, so IC1b stops and the circuit 'hangs' with Q9's output high. This is fine, since it's only the first nine outputs that control the audio. (Remember that the outputs start at Q0!)

When SW1 is pressed, it resets IC2 so that Q0 goes high and Q9 goes low. With Q9 low, the output of IC1a rises and starts up the clock again. IC2 now

counts up through outputs Q0 to Q9. Once Q9 goes high, the output of IC1a falls, stopping the clock and again the circuit hangs with Q9 high.

The first nine outputs (0 - 8) provide current to the circuit around transistor Q1, which is configured as a current controlled oscillator. Since the current controls the frequency, if we control the current we can create different tones. By adjusting trimpots VR1 through VR9, you can create different notes and different tunes — which is great because musical doorbells with one tune can get a bit boring after a while.

Although it's not shown, you can easily connect the audio output to a small power amplifier and place the speaker in an appropriate position for all to hear.

And that's it. It's a fairly simple circuit, but it also has applications in other fields. You can also think of this circuit as a digital monostable as well, where the monostable period is equal to nine clock cycles. It's especially useful in control circuitry where you need a series of clock pulses to perform a certain task.

You're also not limited to just nine outputs with this circuit either. If you have a tune in mind that has fewer notes, then just connect up the input to IC1a to one of the other outputs from IC2. For example, if you had a six-note tune instead, just replace output Q9 with Q7 and leave outputs Q8 and Q9 open circuit.

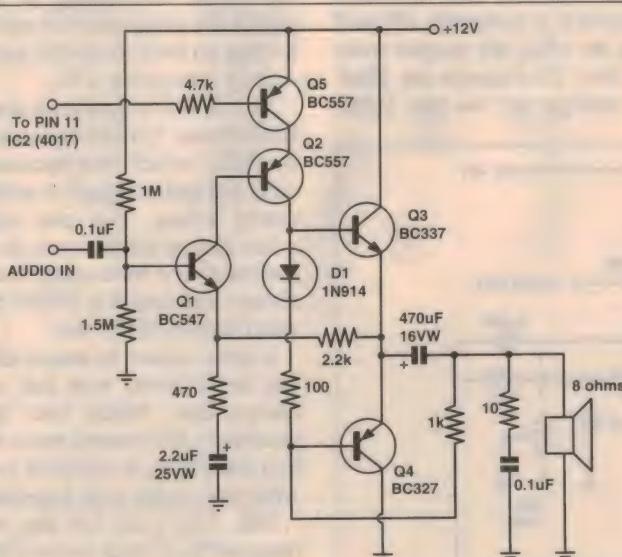
Another good point about this circuit is that since it's CMOS, it consumes very little power in its quiescent mode (apart from the amplifier), so battery operation for this circuit is a definite possibility.

Voltage-controlled Amp

Of course it's pretty pointless running that last circuit from batteries if the amplifier is going to be sitting there slurping up a few milliamps all the time for no reason at all. Your batteries might last a week, but that's about all.

This next circuit in Fig.4 connects up to Fig.3 nicely and only consumes current when the doorbell is pressed. Once the chime has completed, the amplifier

Fig.4



powers down or ‘goes back to sleep’, consuming only what the CMOS circuitry uses.

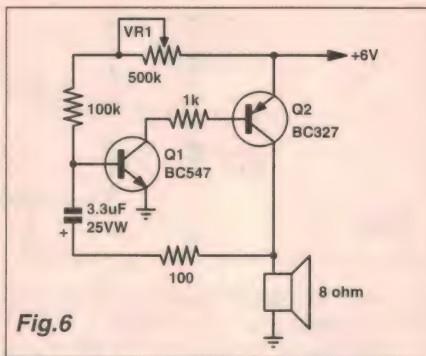
Looking at the circuit in Fig.4, it might look to many pretty much just like a common transistor amplifier. Well, it almost is, except for one extra transistor in the input stage. Rather than being used as an amplifier, transistor Q5 acts merely as a switch. While output Q9 from IC2 is low, the transistor Q5 is biased on, allowing current to flow through to the driver transistor Q2 as well as amplifying transistor Q1.

When output Q9 goes high, transistor Q5 turns off. This causes the amplifier to nicely shut down, since there is now no current feeding either the DC or AC part of the amplifier.

With this control circuitry in place, the batteries should last around a year or so — possibly more depending upon its use and the type of batteries you use. Because of its longevity, I suggest you use leakproof batteries.

The amplifier circuit itself is a simple four-transistor type that should give you around 1W into 8Ω , from a 9V battery. You could use this circuit in many other projects as well, such as a portable amplifier for your personal stereo — however you'll need two for this (one for each channel).

Interestingly enough, there have been one or two amplifier designs over the years where the input signal controls the amount of power delivered to the amplifier. Instead of a fixed supply rail, control circuitry looks at the input signal and then feeds the power amp with just enough power to handle that level of signal without producing distortion. It's tricky, but it does add a bit to the amplifier's efficiency — more so at lower volume levels.



Metronomes

Metronomes

Despite earlier comparisons between today's music and metronomes on steroids, metronomes are themselves extremely useful — especially if you're learning to play a musical instrument. While it is true that metronome circuits are a dime a dozen, it would be remiss of me not to include a couple of basic circuits for you to build on.

Because it is such a simple circuit, we've presented two versions which effectively do the same job - one using an IC and the other using a couple of transistors. The IC version is based around a 555 while the second, which is less efficient, uses only two transistors and a handful of components.

Looking at Fig.5, this circuit is really just an astable multivibrator running at a very low frequency. Metronomes usually only run from 15 to 240 beats per minute, so we're not talking about runaway frequencies here. Pot VR1 controls the frequency of oscillation of the 555 timer, which drives the speaker via a DC-blocking capacitor and transistor Q1. This transistor is normally off and only switches on when the output from the 555 falls low. This causes the 10uF capacitor to charge up via the 100Ω

resistor, which at the same time biases Q1 on for a short time. A brief pulse of current flows through the speaker, which is heard as a 'tick'.

The second circuit, in Fig.6 is even simpler, using an NPN and a PNP transistor, and a few other components. The circuit relies on the 3.3uF capacitor not being able to change voltage quickly to drive transistor Q1 fully on and off. It's simple, crude and it works. It's by no means kind to batteries, but it will get you out of a jam and shouldn't take more than half an hour to knock up.

Waa-waa effect

This last circuit is not for generating signals, but more for creating effects with the signals you feed through it. It has many names, including a 'waa-waa' pedal, basically because that's the sound effect it gives. It's often used to create the sound of wind through a tunnel, or that of a jet plane passing by.

Looking at the circuit in Fig.7, the circuit is based around transistor Q1 which acts as a selective-frequency amplifier. While it amplifies all frequencies, it amplifies some more than others do. The 'some' is controlled by the twin-T filter arrangement connected in the feedback path, with pot VR2. This circuit also looks similar to a phase-shift RC oscillator.

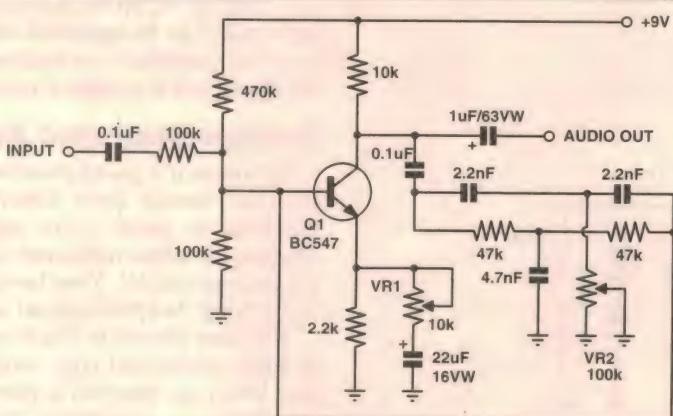
When the circuit is first set up, VR1 is adjusted to minimum resistance. VR2 is then adjusted to the point where the circuit is just oscillating. Next, you adjust VR1 so that it just stops the circuit from oscillating. You should be now able to run VR2 through its full travel without the circuit oscillating. If it does, just repeat the setup process again. If you're having no luck, drop the gain of the circuit by increasing VR1.

The circuit amplifies a small notch of frequencies (which frequencies are set by VR2), which then become accentuated in the audio signal — giving the wind tunnel effect. You can connect up a noise source circuit such as the one we looked at last time using two NPN transistors, and create a simple but effective wind sound effects box.

It never ceases to amaze me how much can be achieved with just a handful of components. While Intel has released processors that contain more than five million transistors, I still think its pretty nifty what you can do with just one or two!

OK. That's all for this month. Next time, we'll get back to our CMOS circuits and continue looking at flip-flops. ♦

Fig.7



NEW BOOKS



Active components

ACTIVE ELECTRONIC COMPONENT HANDBOOK, edited by Charles A. Harper and Harold C. Jones. Second edition, published by McGraw-Hill Books, 1996. Hard covers, 237 x 160mm, 40mm thick (no cumulative page numbering). ISBN 0-07-026692-1. RRP \$160.

A new and fully revised edition of a popular design handbook originally published in 1977 — or more accurately, a revised and updated edition of *half* of the original book, the half dealing with *active* components. As part of the revision, the editors decided to split it into two, in view of the dramatic expansion in material needing to be covered.

As with the original edition, the aim has apparently been to provide a comprehensive reference to selecting, procuring and using any of the enormous range of active components currently available. Which is no small task, considering the gamut covered by such components — from discrete diodes, transistors and thyristors through microwave devices and display devices such as CRTs, programmable devices, memory chips and microprocessors, hybrid and multi-chip modules, to relatively esoteric devices in the photonics and photoelectronics areas.

It's probably inevitable that any book which seeks to tackle such an enormous scope will prove unsatisfying in some respects, especially in comparison with the needs of any particular reader. However on the whole it seems to me to cover most areas fairly well, and certainly provides a huge amount of concise and useful information on a very wide

range of today's active components. For anyone involved in serious electronic equipment design, it would make a very worthwhile reference.

The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (J.R.)

Power supplies

DC POWER SUPPLIES, by Joseph J. Carr. Published by Tab Books, 1995. Soft cover, 190 x 235mm, 323 pages. ISBN 0-07-011495-1. RRP \$49.95.

Although nominally about DC power supplies, this book also has a lot of theory aimed at the beginner to electronics. In fact, only eight of the 19 chapters are about power supplies. The first two chapters give an overview of construction techniques for electronic projects and how power supplies are used, while the third is about electrical safety.

Electrical theory finally starts at chapter 4, starting with the atom and going through all the usual basics, including Ohm's law, series circuits and so on. Batteries are described next, followed by a chapter on AC power, which includes single and three phase systems.

Next comes the use of heatsinks, followed by transformers. To this reviewer, transformers might have been better placed directly after the chapter on AC theory. Three phase 2.4kV transformers are described in some detail; slightly odd in a book aimed at beginners. Rectification is dealt with next, and includes all the usual rectifier circuits — including those for three phase.

Chapter 12 is about voltage regulator circuits, covering three-terminal regulators and a few discrete component circuits. The next chapter presents a number

of power supply circuits that the reader can build. For most there's only the circuit diagram, and no construction details, but a few are explained in more detail and include a photo of the finished unit.

Later chapters include topics like high voltage DC supplies, power supply architecture and alternative power sources like solar cells. Switching power supplies are dealt with very briefly in Chapter 18, and the last chapter is about precision voltage and current sources.

The treatment level is aimed at beginners, but to this reviewer the writing style is rather indulgent, with the author spending too much time on anecdotes.

The review copy came from McGraw-Hill Australia, of PO Box 239, Roseville 2069. (P.P.)

Primer for schools

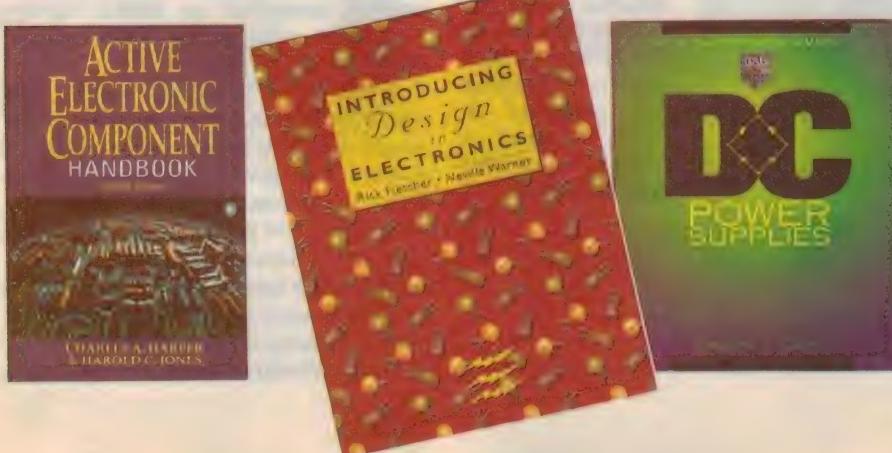
INTRODUCING DESIGN IN ELECTRONICS, by Rick Fletcher and Neville Warner. Published by Jacaranda Wiley, 1996. Soft cover, 280 x 216mm, 100 pages. ISBN 0-7016-3289-5. RRP \$24.95.

An interesting book, this one. It's an introduction to basic electronics and elementary design concepts, intended mainly as a self-paced workbook for Technics students in years 9 and 10 at secondary school. A novel aspect is the so-called 'spiral' treatment, designed to lead students from a familiarity with basic equipment, through elementary theory through to design concepts and practical application examples. It's an interesting approach, and one that steers a course between theory and practice in a way that certainly seems as if it should succeed in attracting and holding student attention.

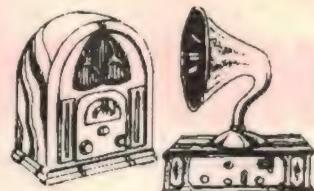
Other nice features include safety tips and interesting 'fact boxes', helpful tips on remembering things like basic theory and component coding, a glossary and a list of suggested further reading.

It's all written in clear, easy to understand language, and profusely illustrated with diagrams and pictures.

My impression is that it should make an excellent workbook for almost any school electronics course — or for any individual wanting to 'get into electronics' on their own initiative. The review copy came from Jacaranda Wiley, of PO Box 1226, Milton Qld 4064. (J.R.) ♦



by ROGER JOHNSON



The Year That Was: 1924

Finding research material covering the Australian scene in 1924 is not easy, but I've been able to find some. However by comparison, that year saw some interesting developments from America. Perhaps the most memorable feature of 1924 is that it was a very expensive year for radio equipment...

The big issue for Australia, of course, was the festering sore of 'sealed sets', and by mid-1924 the matter was finally resolved. Sealed sets have been most eloquently covered by the late Philip Geeves in *The Dawn of Australia's Radio Broadcasting* (an EA publication), but the editorial of *Wireless Weekly* for July 18th, 1924 gives a pretty good summary. It says, in part:

The predominant feature is, of course, the fact that open sets replaced sealed ones. There can be no question but that this will mean a rapid growth in the Australian Wireless Industry, attended, it is to be hoped, by a large absorption of Australian-made apparatus...

...The vexed question of 'What is an experimenter' hinges around the clause containing particulars of the amounts to be charged Experimenters. The statement that the applicant must possess sufficient knowledge to undertake scientific research is altogether too broad to discuss.

The concern about 'experimenters' is that experimenters paid a lesser licence fee, as can be seen from the scale of fees shown in Fig.1. It seems that any 'two-bob lair' game enough to knock up some sort of receiving apparatus, using as much 'jerry-built' home-made equipment as possible, could classify himself as an experimenter. Why not?

Technically, 1924 was a milestone year for the introduction and intensive marketing of the 201-A and other 'dull emitter', or low consumption valves. The 201-A was the development of the 201, and had a filament consumption of merely 250 milliamps instead of the previous 1A. Also advertised was the low consumption 'dull emitter' types Cunningham UV-199 and Weco 'Peanut' valves. The usual run of Marconi D.E.R.'s, Ediswan A.R.'s and Philips DI and DII valves were still available; but surprise surprise — the newer types could cost half as much again as the existing bright emitters!

Seen in the United States, but not to be available in Australia for another 12 months or so were the DeForest 'DV' series of tubes, which required a filament current of only 60mA.

Prices in 1924

Prices being asked during 1924 for radio parts and receivers seem to be some of the highest ever during the vintage era. One should remember the 'conversion rates' described in this column in a previous issue.

There were the usual run of home constructor sets (see Fig.2), which ranged in price from £5/10/0 (\$11.00) to £13/13/0 (\$27.30), but presumably this price did not include a loudspeaker — which, depending upon the brand, could cost as much as the receiver itself! There were some very, very highly priced receivers, such as the 'Volmax' brand from Wireless Supplies Ltd, of Royal Arcade, Sydney. Here is what was being offered:

'THE VOLMAX RD SET': Four valve receiver (RF, detector and two audio) complete with all accessories and loudspeaker. Ideal for ranges up to 400 miles... £55/10/- (\$111.00)

'THE VOLMAX RE SET': Five valve (2 RF stages, detector and two audio), complete as above. Giving excellent results to 1000 miles... £65/- (\$130.00)

'THE VOLMAX RF SET': Five valve as above, but with 'push pull' audio amplification; same range as above, but gives louder operation. Price complete... £94/10/- (\$189.00)

In 1924, £94 pounds and 10 shillings was an enormous sum of money — representing approximately four to five months' wages for the wage and salary earner. Clearly these radios were aimed at the professional person or business-



Fig.6: Awaiting careful restoration is this example of the 'British look' — a Sterling 'one anodion' of 1924. It uses a bright emitter type 'E' valve.

man, residing in his Federation-style bungalow in the leafy suburbs of the North Shore...

Other expensive receivers were the top of the range 'COL-MO' from Colville-Moore Wireless Supplies Ltd, of 10 Rowe Street, Sydney. This attracted an asking price of £75/- (\$150.00). There was also the 'Ideal Radio Set' at £95/- (\$190.00) from J. Levenson of 244 Pitt Street, Sydney.

Amalgamated Wireless (Australasia) Ltd, popularly known as 'AWA', was busy making honeycomb coils and audio transformers, and a Mr Stanley Grime headed the production division of AWA in order to prepare for the production of complete sets for the domestic market.

Typical circuits

In *Wireless Weekly* for December 19th 1924, details were given of a good crystal set. A few issues later there was published 'The Complete Set', together with a valve amplifier. There is no tuning capacitor. The tuned circuit relied upon the distributed capacitance between the individual turns of the coil...

The stations (all two of them in Sydney at the time) were tuned via the multiple close interval taps on the large coil. Such a tuning set-up is a high 'L'/low 'C' arrangement, which is the most electrically efficient and affords better selectivity. Such a circuit would probably work fairly well even today.

The American Scene

A glance through three different American publications of the same period has revealed some interesting comparisons. Firstly, prices.

America, with its quite diverse popu-

Open Sets at Last!

NEW REGULATIONS HERE AND PROVIDE FOR THE FOLLOWING

- (a) Open Sets, no restrictions.
- (b) License Fees:

Zone 1 (radius 250 miles), 35/- year.
Zone 2 (extending 150 miles beyond Zone 1), 30/- year.
Zone 3 (remainder of State), 25/- year.
- (c) All licences will be obtained from the Department.
- (d) Broadcasting to be competitive; advertising to be allowed.
- (e) Experimental licenses to be granted bona fide experimenters as under:

Zone 1	20/- per year
Zone 2	17/6 per year
Zone 3	15/- per year

Fig.1: the scale of licence fees for 1924, taken from the July 18 issue of *Wireless Weekly*.

lation and enormous manufacturing ability, naturally had a large number of wealthy people. This 'top end' of the market was well and truly catered for by wireless manufacturers. Fig.3 shows the top of the range sets on offer from RCA Radiola. By comparison, reference to Floyd Clymer's catalog of 1924 cars shows the Chevrolet touring car with a list price of US\$490.00 — almost the same price!

Given the choice, would the reader today purchase a new Chevrolet car, or the latest thing in AM radio? That was a choice on offer in 1924... Even going one step further and comparing a new Chevrolet car with the latest thing in radio/TV entertainment falls somewhat short of the mark.

The other brand names, familiar to readers in this country, were seemingly quite well established. Grebe, Fada, RCA Radiola, Eismann, Zenith, Crosley, Amrad, Peerless, Attwater Kent and Gilfillan all had full-page advertisements and had amongst their range a selection of sets costing between US\$100 and \$200.

Also advertising heavily were the component manufacturers, such as Rola, Brandes and Magnavox speakers; Eveready, Philco and Exide batteries; and of course Cunningham valves.

Despite the ubiquitous 201-A, which was shown in practically every home construction set and specified by many set manufacturers, and costing typically US\$3.00, there were several companies advertising valve repairs. 'Save half the cost on replacement tubes' was the catchery. Imagine — if those firms were in business today, they could probably make a fortune. How many burnt out 201-A's are there? Judging by the advertisements, the valve was disassembled, a new filament was inserted and then it was re-evacuated. A bit like the picture tube 're-gunning' firms which flourished during the monochrome TV era...

Amongst the more blatant hype that was being foisted upon an unsuspecting public was the claim that substances such as 'Bakelite' and 'Formica' improved the range and volume of your receiver! These ads were full page, by the way.

The 'Solodyne' circuit

The Solodyne was the circuit of 1924, for the new four-element tubes. The tubes were called just that, for it seems the name 'tetrode' had not entered the vocabulary.

The Solodyne circuit relied upon the space-charge effect, whereby the 'inner grid' acted as the accelerator, and the outer grid was the signal grid. The 'Hikers One' described in this column for October 1989 is a classic example of what was referred to as a Solodyne in 1924. These circuits operated on very low anode potentials, with the same battery generally used to provide both the 'A' (filament) and 'B' (anode) potentials.

In other words, the effective 'B' voltage applied to the valve anode and accelerator grid — relative to the filament — is merely the potential drop in the fila-

SIGNAL Home Assembly Sets



Model Phone valve, £5-10-



Model Q 2 valves, £9-9-
Model R three valves (Audio Freq.) £11-11-



Model S three valves (Radio Freq.) £11-11-

Model T four valves (Radio Freq.) £13-13-

Fig.2: Again from *Wireless Weekly* for July 18th 1924, this advertisement shows the range of 'Signal' sets for home assembly.

ment rheostat. (The rheostat had to be in the positive lead, of course.) The circuits given in *Radio News* for September 1924 specify a six volt accumulator, used with a 4V tube run with 3.5V on the filament. This means that the valve(s) had an effective anode and inner grid potential of merely 2.5 volts. Not bad, eh?

What a motley collection there are. Of the five circuits described, there is (a) a one-valver laid out as an RF amplifier and with crystal detector (Fig.4); (b) a one valve reflex; (c) a two-valver with RF amp and leaky grid detector; (d) a two-valver of detector and audio; and (e) a super-regenerative circuit.

Curiously enough, there is no mention of the actual valve type to be used. Neither does there appear to be any mention of a four-electrode tube in any of the advertisements. The ads for tubes are either 201-A's or UV199's...

The naivety of some of the reader queries in the American magazines were only exceeded by the over-simplification of the answers provided. It is a bit like the *Monty Python* sketch giving instructions on how to play the flute: 'Simple, you blow through this little hole up one end, and twiddle your fingers over the holes at the other and then you get a tune'!

Here is an example from a reader identified as R.H.D. from Seattle, Washington State, who asks: "How do I add one stage of radio frequency amplification to my honeycomb coil set, indicating the necessary switches for cutting out the radio frequency stage when it is not required?". The answer from

	Radiola X with four WD-11 Radiotrons.* Loudspeaker built-in.	\$245	Loudspeaker operation up to 2000 miles under favorable conditions.	Outdoor or indoor antenna.	Extraordinary selectivity. Non-radiating.
	Radiola Super-Heterodyne with six UV-199 Radiotrons* and Radiola Loudspeaker. Same without Radiotrons or Loudspeaker.	\$286 \$220	Loudspeaker operation up to 2000 miles with internal loop. With external loop up to 3000 miles under favorable conditions.	No antenna. (Concealed small loop built into set.)	Super-selectivity. Non-radiating.
	Radiola Super-VIII with six UV-199 Radiotrons. Loudspeaker built-in.	\$425	Loudspeaker operation up to 3000 miles under favorable conditions.	No antenna. (Concealed large loop built into set.)	Super-selectivity. Non-radiating

Fig.3: Some of the more expensive sets on offer in America by RCA in 1924, as part of their Radiola range. A Chevrolet touring car was priced at US\$490 at the time — not much higher!

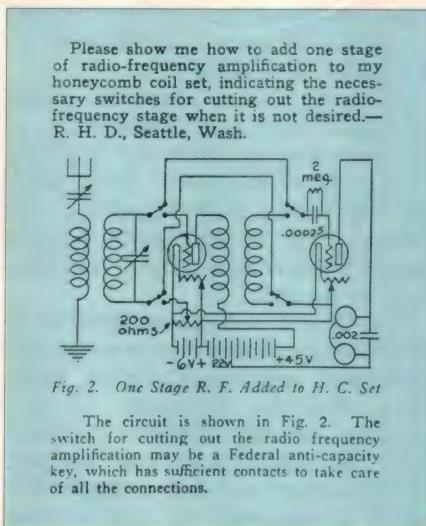


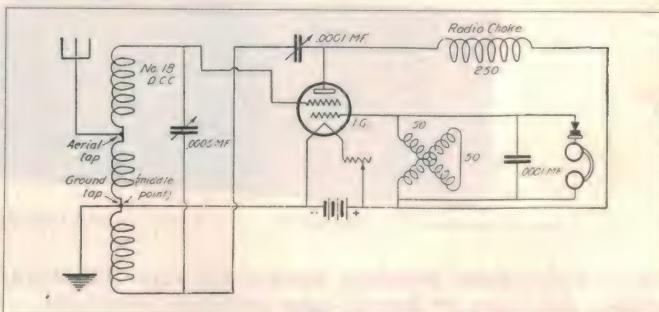
Fig.5: A simple answer to a simple question! How to add an RF stage to a set, as explained by Radio Magazine's Gerald M. Best in April 1924.

Radio's Gerald M. Best, with all of a dozen words of text, is shown in Fig.5. What could be simpler?

The English scene

One thing that became apparent from

Fig.4: One of the Solodyne circuits published in the US magazine *Radio News* for September 1924, to suit the new dual-grid valves. Note the single 6V battery.



glancing through the illustrations in the American publications is that practically all advertised sets in 1924 were of the familiar 'coffin box' variety, or designed into a piece of drawing room furniture. The same could not be said of English sets, though.

A glance through the illustrations in British magazines of the period show that the American style 'coffin box' was very much in the minority. Typically, a British set had externally mounted valves and coils, on either a flat, vertical or sloping panel, and in the case of an enclosed set, the front panel was more often square, and not oblong. Fig.6 shows a 'Sterling' one-valve set which rather nicely illustrates the point. Two and three-valvers were extremely common, and British sets tended to be more compact than their American (or Australian) counterparts.

British sets of 1924 had quite the appearance of a piece of scientific apparatus, and could be described as quaint rather than functional. Many collectors find that the British style of externally mounted valve(s) and perhaps coils as well, is somewhat pleasing to the eye, but I guess it's all a matter of taste. ♦

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NEW RANGE OF ENHANCED
PRINTERS FROM EPSON,
MONITORS FROM PHILIPS

REVIEW: VISIO TECHNICAL 4.1



THE NEW 5200 'POWER MANUFACTURING DEFECTS ANALYSER' FROM MARCONI INSTRUMENTS: HIGH SPEED, COST EFFECTIVE VECTORLESS PCB TESTING FOR HIGH-VOLUME MANUFACTURERS. WINDOWS SOFTWARE ALLOWS RAPID DEVELOPMENT OF TESTING PROGRAMS FROM CAD DATA

NEWS HIGHLIGHTS

RIVERSIDE CORP PARK: STAGE 2 LAUNCHED

Riverside Corporate Park in North Ryde, NSW has entered Phase Two of its development with the release of a further 84,000m² of land and the opening of the Riverside Corporate Park Village. Prime Minister John Howard also announced a further \$37 million investment in RCP by leading superannuation company Industry Superannuation Property Trust (ISPT).

Touted as 'the apex' of the North Ryde technology triangle, RCP is a revenue neutral project devised by the CSIRO for its 30ha North Ryde site. It is managed by Australia Pacific Projects Corporation (APP), and all revenue generated from the release of government-owned land is being re-invested back into the Park to ensure a quality environment.

The Park is specifically designed for major players in innovative industries,



and has already attracted Fujitsu Australia and medical group Gradiopore.

APP project director for Riverside Mr Brian Tasker said that "Primarily, Riverside is a corporate park with a

strong grounding in research and development, and technological excellence. The inclusion of retail and leisure facilities within the Park's parameters encourages better time management and

has agreed to fund the development of a production prototype of the Vanadium Redox Battery developed by UNSW's Professor Maria Skylla-Kazacos.

The battery technology is already being developed further by Mitsubishi Corporation in Japan, for heavy power applications. J.C. Ludowici & Son Ltd will be involved with the commercial development in Australia.

"The funding is made available under

the Federal Government's Renewable Energy Industry Program administered by the Department of Industry, Science and Tourism, and will advance this promising green Australian technology", said Mr Peter McGauran, Minister for Science and Technology.

"It is an Australian innovation which is already gaining some international recognition, and the Federal Government is anxious to ensure that the technology is developed so that Australian enterprise and creativity gains credit, both professionally and economically," he said.

Mr Richard Kaan, Managing Director of Unisearch, said the Government initiative would play a key role in ensuring that an Australian innovation was not lost to Australia.

"This will help us keep the financial and development benefits of the technology in Australia," he said. "The battery has the potential to power motor vehicles and to provide storage of energy for factories, for villages and emergency services in remote locations. In fact it has the potential to revolutionise much of the way in which we store and use energy."

FED GOVT BACKS OZ BATTERY TECHNOLOGY

The Federal Government has backed an Australian invention which will allow commercial development of a renewable-energy battery, which could be used to power motor vehicles. Unisearch Limited, the commercial arm of the University of NSW, has announced that the Federal Government

NCA LAUNCHES CABLE TELEPHONY

The first cable telephony facility in regional Australia has been launched in Ballarat by Northgate Communications Australia (NCA). Senator Richard Alston, Federal Minister for Communications and the Arts, officiated at the launch and demonstrated the quality and accessibility of the system by calling the Prime Minister, John Howard.

The new facility represents a \$20,000,000 direct investment in Ballarat by NCA, and is the only cable project in Australia constructed with the approval of local government.

NCA is the first company to construct broadband communications networks in regional Australia, and is developing fibre optic and coaxial telecommunications systems in over 40 regional centres throughout Australia. The cable system passes every home and business in the community. It currently supplies cable television services, and will provide competitive telephony and high speed data communications when the telecommunications market is deregulated after July 1 this year.

NCA is affiliated with Northgate Communications Inc., a Los Angeles based broadband system operator. Both NCI and NCA are owned by a group of investors in the USA.

WINNERS OF THE 100MHZ HP SCOPES

There were two winners of the Electronics Australia/Hewlett-Packard subscription competition run in the magazine for the period October 1996 — January 1997 inclusive. The lucky winners were Mr T. Way, of Glenalta South Australia, and Mr Robinson of Parkdale, Victoria.

Each winner has now received a superb HP 54645A 100MHz dual channel Digital Oscilloscope, valued at \$5200. We congratulate the winners, and thank Hewlett-Packard Australia for their sponsorship of the competition. We'd also like to thank all readers who subscribed or renewed their subscription during the period, for their participation and support of the magazine.

TOSHIBA DEVELOPS 1.3M PIXEL CMOS SENSOR

Japan's Toshiba Corporation has announced the fabrication of a prototype 1,300,000 pixel complementary metal oxide semiconductor (CMOS) image sensor. High-resolution images captured by the new image sensor were successfully demonstrated.

The new device operates on a single 3.3V power supply, has an image area of 1318 x 1030 pixels, and meets the requirements of the 1280 x 1024 pixel SXGA format — currently the maximum resolution supported on monitors. CMOS devices use much less power than comparable charge-coupled devices (CCDs) as image sensors, and can potentially be made much smaller, making them ideal for future ultracompact digital cameras and portable videophones.

The market for digital cameras is showing explosive growth and domestic demand is projected to reach two mil-

lion units in 1997, with strong demand for cameras that will combine high resolution and low power consumption in a compact package. Again, miniaturization and higher resolutions promise to facilitate innovative future products such as personal computers with built-in cameras and portable videophones.

The 12mm square sensor chip has cells 5.6um square, made using a 0.6um CMOS design rule. It uses only 30mW of energy.

DSOs, in exchange for royalties.

"Both Fluke and LeCroy have considerable expertise in developing and commercializing DSOs", says Tom Nealon, manager of Philips Test & Measurement which represents both Fluke and LeCroy in Australia and New Zealand. "Fluke is a leader in the hand-held test tool market, including hand-held DSOs with integrated meter capabilities. LeCroy is a leading provider of DSOs for the high-end test and measurement market."

Charles Holtom, Philips T&M Oscilloscope Product Manager, added "LeCroy's DSOs are designed to provide the 'complete picture' of an electronic signal by capturing, viewing and analysing it with sophisticated technologically advanced products".

"This is a win-win situation for both Fluke and LeCroy," said Tom Nealon. "We are very pleased about the agreement, as both companies complement each other in product and technical capabilities."

EXIDE BUYS DELTEC UPS BUSINESS

Late last year Exide Electronics Corporation entered into negotiations with Schneider Automation (formerly Online Control) to purchase from them the very successful Deltec uninterruptible power supply distribution business. This was finalised in early January and a new company, Online-Deltec Pty Ltd was formed.

As a wholly owned subsidiary of Exide Electronics Corp., Online-Deltec will combine forces with Exide's own presence in Australia (currently sold under the brand name PowerWare) and as a result will become one of the largest UPS suppliers in Australia.

The amalgamation will provide some substantial benefits for both existing customers and new partners including

Leading test instrumentation firms Fluke Corporation and LeCroy Corporation have signed a technology licensing agreement under which LeCroy will provide Fluke with access to certain advanced technology, for use in future digital storage oscilloscope (DSO) products including hand-held

RAAF EXTENDS RADAR CONTRACT



The Royal Australian Airforce is entrusting the maintenance of the on-board radar systems in its F/A-18 Hornets to Philips until the end of the year 2001.

Philips has been responsible for the radar maintenance program since 1989. However this latest decision follows an investigation and tendering process in which all options were considered — including the RAAF undertaking the maintenance itself. Work on the radars is handled by a specialist team at Philips Manufacturing Centre, Moorebank.

The new multi million dollar contract continues the strong RAAF-Philips business relationship which began in 1983 when Philips started building the 72 APG-65 radars under licence from the Hughes Aircraft Company. The F/A-18 Hornet is Australia's front line jet fighter aircraft. The attack radar, housed in the Hornet's nosecone, allows the fighter's advanced weapons systems to engage and destroy unfriendly aircraft.

NEWS HIGHLIGHTS

access to a much broader product range, local warehousing and increased service and back-up support facilities.

Online-Deltec's office in Melbourne has been relocated to an office warehouse complex that offers additional warehouse space and a service centre. In April, the Sydney head office and Brisbane office were also moved to new premises that include substantially increased warehousing and service facilities.

R&D APPOINTED PHILIPS STOCKIST

Philips Components has appointed Melbourne and Sydney based R&D Electronics Pty Limited as Authorised Stockist for Philips Components, effective February 1 1997. R&D Electronics will sell the entire range of Philips Components products including Philips Semiconductors, microcontrollers, Logic, I^C Bus, audio, video, RF, linear, programmable Logic, transistors and diodes. Philips' passive range of components will also be supported including resistors, capacitors and ferrites.

R&D Electronics can be contacted in Victoria on (03) 9558 0444, or in NSW on (02) 9638 0077.

IHS & ACEL MERGE

IHS Australia and ACEL Information have merged. The newly merged organisation is known as IHS Australia, which is now claimed to be the largest supplier of technical information and industry standards in the Southern Hemisphere.

Customers of the new organisation will now have access to a much broader and comprehensive range of products and services. All existing ACEL Information products and services will continue, as will the IHS Australia products and services. However, the firm plans to expand the range and depth of our services, to provide the best information at the most cost effective price.

NZ'S SKY NETWORK USING S-A SYSTEMS

Sky Network Television Limited, New Zealand's largest Pay TV operator, is installing a Scientific-Atlanta satellite system to extend coverage of its national service.

Sky Television currently operates a five-channel UHF terrestrial network that reaches more than 70% of New Zealand households. After evaluating several alternatives, a satellite delivery system was chosen as the most cost-effective way to reach homes beyond its terrestrial coverage area.

Sky Television is initially offering one analog video channel of sports programming via a single transponder on an Optus B satellite. This service was scheduled to begin in April 1997. Planning for a multi-channel digital service is already underway.

Scientific-Atlanta is supplying two earth stations and a full uplink chain for the video signal. A nine-metre antenna will be used to transmit video signals to the Optus B satellite, while a six-metre antenna will be used to downlink from other regional satellites. Satellite broadcasts will be delivered using Sky Television's existing terrestrial conditional access system.

MITA COPIERS CAN 'PHONE HOME'

Office photocopiers have a reputation for unreliability, for being out of service for hours or days before a service technician arrives, and then for taking many hours before their faults can be diagnosed and fixed. Now Mita, one of the world's largest manufacturers of copiers, claims to have come up with

the solution to these problems: the Mita Monitoring Device (MMD), a modem which links the copier to the phone line.

The MMD is claimed as an Australian first, and to represent the latest in information technology. When fitted to selected copiers, the MMD modem automatically monitors all photocopier functions and automatically reports any copier service problems to the Mita service centre. This means some servicing can be carried out electronically via the service centre's computer link, which means less down time and higher productivity.

The MMD automatically monitors for loss of copy quality, problems with paper feed and parts failure, and also reports meter readings and provides a comprehensive performance history. As a result when a copier breaks down Mita makes the first move by phoning the user, advising them of the exact problem and rectifying it quickly and efficiently. Even when the copier is running smoothly, it is constantly being monitored through the MMD.

\$5M CHINA CONTRACT FOR DATA ELECTRONICS

Melbourne based Data Electronics has signed a \$4.5 million contract to supply 6500 of its data loggers to monitor rainfall and river heights in China. The loggers will be used in the first phase of an extensive upgrade of hydrological monitoring throughout China. The contract was signed at a ceremony at the Australian Embassy in Beijing, attended by the Deputy Minister for Water Resources Mr Zhou Wen Zhi and the



Australian Ambassador Mr Rick Smith.

In his speech at the signing, Vice Minister Zhou stressed the importance of the project to China. He outlined the humanitarian and economic benefits that would flow from it and the critical role hydrology plays in China's water resources management. The improved data collection resulting from the system will enable better flood forecasting and great savings in both life and property damage.

Vice Minister Zhou also expressed his appreciation of the assistance from the Australian Government for the Project. This

was by way of a loan provided under Australian aid funding.

Tony Schauble, Data Electronics Marketing Director, explained the history of the data logger to be supplied. "This product has been developed in close cooperation with the Ministry of Water Resources in China and our engineering staff in Australia. We now have a field proven data logger that meets the exact needs of our client in China. We are confident that it will find application in other countries as well."

TECH-RENTALS LINKS WITH YOKOGAWA

Yokogawa Rental & Lease, Japan's second largest instrument and computer rental company, has joined forces with the Australian based Tech-Rentals in a strategic marketing alliance to assist their clients in SE Asian countries.

Many of Japan's major manufacturers have established manufacturing plants in the region, and Australian and Japanese companies are also active in infrastructure development projects. Electronics manufacturing and telecommunications developments are dominant and the two rental companies are well experienced in supporting customers in these areas.

Tech-Rentals was established in Australia in 1978 and is now the country's largest test equipment rental supplier. Additional offices have been established in SE Asia, New Zealand, and Eastern Europe over the past two decades. The Singapore office was opened in 1985 and the most recent office in Kuala Lumpur commenced operations ten years later.

Yokogawa Rental & Lease is part of the major process control instrumentation group Yokogawa Electric Corporation. The group is active throughout the world including Australia. Apart from offices in Japan the company has a facility in Korea and is active in the Taiwanese market.

EMC: GOVT APPOINTS FIRST COMPETENT BODY

With new legislation which became effective from January 1, 1997, Australia is fast moving into line with Europe and other major developed countries in its ability to understand and control the phenomenon of electromagnetic interference. A small company called EMCSI (Electromagnetic Compatibility and Systems Integration) formed just under two years ago, is the first to be appointed by the Federal Government as Australia's first Competent Body, in

Soldiers taking a technician course at the British Army's School of Electronics watch a demonstration of antenna modelling, using a system developed by Feed Back Instruments of East Sussex.



relation to this new legislation.

Announcing EMCSI's appointment, Mr Ian McAlister of the Government's Spectrum Management Agency said the Melbourne-based company had been appointed because of its experience, its expertise and access to high quality, accredited testing services.

EMCSI's Managing Director Mr Cornelius Chidlow and Technical Manager Dr Franz Schlagenhaufer have extensive experience in EMC systems and are at the forefront of EMC work, not just in Australia but also in Europe. Mr Chidlow has been responsible for the EMC design, analysis, test and management for an extensive range of projects, both large and small. Through many years' experience in test laboratories and working with equipment designers, manufacturers and system integrators, he has

gained a thorough understanding of EMI/EMC at all levels.

Dr Schlagenhaufer has planned, supervised and implemented EMI/EMC analysis problem solving for a wide range of equipment and systems. He established and managed a major European EMC test facility based in Germany, and led it successfully through accreditation.

...AND THEN ANOTHER

The Australian Government has appointed EMC Assessors Pty Ltd as a Competent Body to assess the compliance of products with the new EMC Framework. EMC Assessors was formed by four of Australia's most experienced EMC and RF design engineers — Ian Shearman, Ray Garrett, Geoff Sizer and Ian Macfarlane — to become a Competent Body under the Electromagnetic Compatibility (EMC) Framework, Australia's equivalent to the European EMC Directive.

From the 1st January 1997, most new electrical and electronic equipment sold in or imported into Australia must be certified as conforming with the EMC Framework requirements and bear a compliance mark (the 'C-tick'). The framework is being phased in over the next two years and will require all electrical and electronic products and systems to comply by 1st January 1999.

EMC Assessors offers services to manufacturers, developers, importers, wholesalers, retailers and re-sellers of electrical and electronic devices, to assist such organisations in meeting their obligations under the EMC Framework. For further information, contact Geoff Sizer by phone on (02) 9144 3060, fax on (02) 9488 9762, e-mail to gsize@ozemail.com.au, or visit http://www.ozemail.com.au/~gsizer/emca_ss.html. ♦



US antenna specialist Andrew Corporation, of Orlando Park in Illinois, has just introduced this Super Power HMD Series antenna for MMDS 'wireless cable' digital TV transmission. It handles up to 1280W of average power.

68HC05 DEV SYSTEM UPDATE

Since its introduction in 1993, the Oztechnics 68HC05 development system has undergone a number of upgrades not only to keep up with technology, but also to add new features. Here we look at the latest version, which includes a range of new features and an upgraded programmer board to cater for the ever expanding 'HC05 family of microcontrollers.

by PETER PHILLIPS

In March 1995, Motorola announced the sale of its *one billionth* microcontroller unit (MCU) from its 68HC05 family of microcontrollers. There are now 180 variations in the HC05 range, with some priced at less than US\$1. Many of these are for specific applications, but the facts speak for themselves: this family of MCUs is the world's most popular.

For Oztechnics, the ever-increasing range and popularity of the 'HC05 range means continual updates of the company's development system to at least accommodate new MCU releases. The latest version (3.5) now supports 21 versions of the 'HC05 family. These are the 68HC705C4, C8, C9, D9, J1A, J2, K1, SU3, SR3, P6, P9, B5, B16, MC4, P18, SP3, E1, P3, U3, R3 and the 68HC805C4.

We've reviewed the Oztechnics 68HC05 Development System before (see EA July 1994 for a comprehensive review), but a short overview of the system may help remind you of what the system does.

The system

The system comprises software and hardware. The software includes a text editor which is the main working environment for developing code. It has all the features of a wordprocessor (cut,

paste, copy, search/replace, undo, multiple files open with cut and paste between them, and so on). It's mouse (or keyboard) driven and has a built-in programmer's calculator (decimal to hex, etc), ASCII chart and an extensive help file, of which we'll say more.

A very useful feature for professional programmers is a file work time history, which logs the time spent on the file. This lets a programmer keep a log of the actual time spent when determining the amount to invoice a customer.

The editor is integrated with an assembler, simulator, programmer and diagnostics software. These functions are all accessed from within the editor via function keys or mouse operated menus.

After writing a program in the editor, the next step is to assemble it — achieved by pressing a function key. After assembly, any errors in the program are displayed in a small window at the bottom of the page by highlighting the line(s) in question. The first line is automatically selected in the text editor, ready for correcting.

After errors have been corrected, the program can be run in the simulator for testing. The simulator shows register operation and all the usual I/O operations, and also allows external data to be

entered via the keyboard. Once the program is debugged, it can then be downloaded to the microcontroller's EPROM, via the system hardware, which is a programming board connected to the computer. This board accepts all the above listed micros, although some need an adaptor board.

Updated help

As already mentioned, this new version supports a wider range of MCUs and now has expanded on-line help. When the help function is accessed, a menu appears as shown in the screen dump in Fig.1. From this menu you can look at the full 'HC05 instruction set, or select one of four MCUs to see its pinouts and brief details. For further information about the device, you point to any text entry on the diagram. For instance, to get more details about the registers in the device, you point to Registers, where another graphic will be displayed showing each bit of the available registers.

Virtually everything you need to know about these devices can be found through the hypertext. Although only four devices are listed, these represent most MCU types in the family. The help function also gives the editor

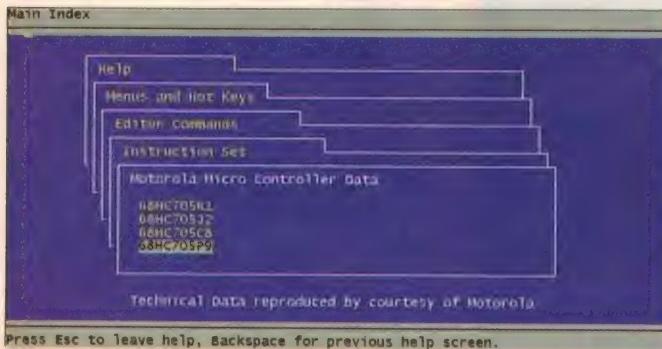


Fig.1: Two of the screens available with the Oztechnics software, by accessing the Help function. It makes extensive use of hypertext links.



The latest version of Oztechnics' 68HC05 programmer & In-Circuit Simulator module. It hooks up to either the Centronics or serial ports of a PC, and is powered from a 12V DC plugpack.

commands and other information.

Programmer board

The new programmer board has a number of additional features compared with the previous version. The programming voltages for each supported micro can now be set with

Competition

Oztechnics has kindly donated a 68HC05 Development System to be awarded as a prize in a competition. To enter the competition, send us a brief description of what you believe is an innovative use for a 68HC05 microcontroller. The prize will be awarded to the reader who, in the opinion of the judges, sends the most innovative application.

To enter, send your description to: 68HC05 Competition, Electronics Australia, PO Box 199, Alexandria, NSW 2015. Entries close 30 May 1997.

trim pots, and of course, the board has been expanded to accept the wider range of devices supported by the software. The board accepts all DIP package MCUs, and adaptor boards are supplied to program SOIC and PLCC packages.

The programmer board connects to the parallel and serial (optional) ports of an IBM PC, and is powered by a 12V DC plugpack. Diagnostic software is now included in the package to fully test the board and the interconnections to the computer.

Programming is fully automatic, including selection of the correct programming voltage for the required MCU.

Features of the board include EPROM dump display, program verify, blank test and batch programming, and the programming software also checks the loaded *.S19 file against the specified controller, and reports any anomalies.

Other features

Included with the package are several sample files from the Oztechnics car computer, supplied for evaluation and educational purposes. There are three files, each relatively short but fully operational. These let you operate all aspects of the program (simulator, editor etc) to get a feel for the package and to learn programming techniques.

The in-circuit simulator allows all I/O processing to be done externally by the target hardware. The circuit under test is connected to the in-circuit emulation (ICE) socket on the programmer board via a multi-way cable. A C8 controller programmed with the supplied monitor program is then fitted to the programmer board to perform all I/O processing.

A demonstration version of the full package is also available for free. This version allows all aspects of the software to be evaluated, with the limitation that any files you create cannot be saved to disk. The software can be downloaded via the Internet from <http://www.oztechnics.com.au/>. The package has an RRP of \$500, which includes the programmer board (fully assembled), software and example files.

For further information contact Oztechnics P/L, PO Box 38, Illawong 2234; phone (02) 9541 0310; fax (02) 9541 0734, email HC05@oztechnics.com.au or visit the above listed Internet address. ♦

THANK
GOD
FOR THE
SALVOS



NEW PRODUCTS



High speed test system

The new 5200 power manufacturing defects/analyser (power MDA) from Marconi Instruments is a high speed circuit board test system, for high volume PCB manufacturers. It features vectorless testing (Marconi's Q-test is configured as standard), and new 'power-on' test techniques. It has comprehensive software tools for program generation, and graphical commissioning and debugging tools. It also has PC Windows-based computer assisted program generation (CAPG) software so

test programs and fixture designs can be developed manually or from CAD data.

The 5200 comes in a 19" rack mountable case, and can be configured with an in-line handler for integration into automated production. In stand-alone form it can be configured with low-cost vacuum, pneumatic or mechanical fixturing.

For further information circle 244 on the reader service coupon or contact Marconi Instruments, 1/38 South Street, Rydalmerle 2116; phone (02) 9638 0800.

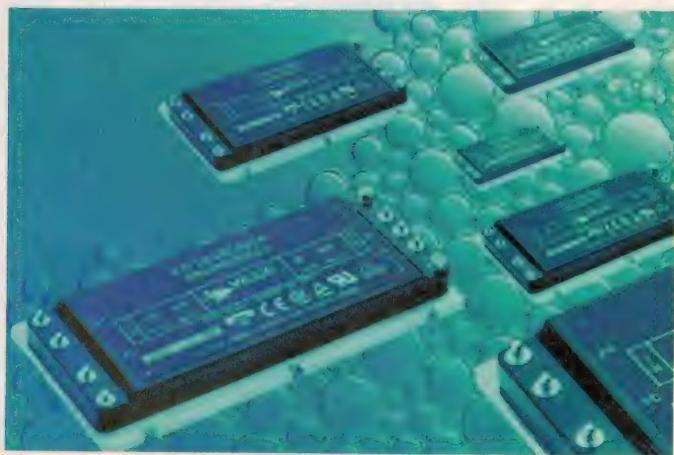
Mini current probes

The K series of measurement probes from AEMC is a new line of current probes claimed to have exceptional DC/AC current measurement capabilities. They comprise a sensing probe attached via a 1.5-metre cable to an electronic module that connects directly to a DMM. Their small size and shape makes them suitable for use in tight wiring areas on circuit boards, in 4-20mA process loops or automotive electronic circuitry.

Two models are available. The K100 has a 1mV/mA output and suits currents to 4.5A DC, 3A AC (sinusoidal), or 2A AC peak, square or non-sinusoidal waveforms, with a frequency response to 2kHz. The more sensitive K110 (10mV/mA) is for currents up to 450mA DC or 300mA AC (sinusoidal) and 450mA peak, square or non-sinusoidal waveforms and has a frequency response to 15kHz. Basic accuracy is 1% and 0.5% respectively. Probes have a 50uA DC resolution, and feature true RMS measurements with total DC+AC component.

Both models are powered by a standard 9 volt battery, giving a life of about 20 hours for continuous running.

For further information circle 241 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 9698 4111.



600 watt DC-DC converter module

Vicor's new 600W component-level DC-DC converter module measures 116.8 x 55.9 x 12.7mm and has a nominal input voltage of 375V DC and an output of 48V. Efficiency is 90%. The input range is 250 to 425V (optimised for use with a power factor correcting front end) and the output is programmable from five to 50V. It is designed for telecommuni-

cations rectifiers and any bulk power conversion application for distributed power architectures. Modules can be connected in parallel.

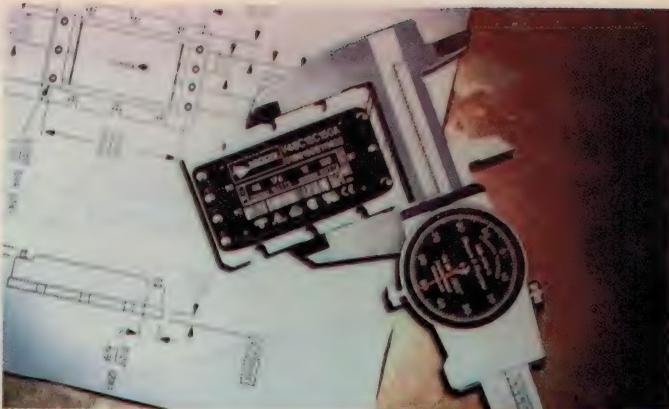
For further information circle 250 on the reader service coupon or contact Powerbox Australia, 4 Beaumont Road, Mt Kuring-gai 2080; phone (02) 9457 2200, email address sales@powerbox.com.au.

Flexible battery chargers

Amtex has extended its range of LX switch-mode battery chargers. Power levels of 200W, 300W, 350W, 550W and 750W are now available, and units can be paralleled for power ratings up to 5kW. The range includes output voltages of 12, 24, 36, 48, 60 or 110V, or custom voltages can be specified. Single phase or three phase AC input is now standard. Features include

constant voltage or constant current operation, and over voltage protection. Power fail and battery low alarms are included. All units can also be supplied with any DC input voltage.

For further information circle 243 on the reader service coupon or contact Amtex Electronics, 2A Angas Street, Meadowbank 2114; phone (02) 9809 5022.



150W micro size DC-DC converter

Vicor's new 150W DC-DC converter module measures 57.9 x 36.8 x 12.7mm — one third the size of the company's full size module. The new converter has a nominal input voltage of 48V DC and provides a 12V output at an efficiency of 86%.

The input voltage range is 36 to 75V and the output is programmable from 1.25 to 13.2V. Input conducted noise and output ripple are

minimised by Vicor's proprietary zero current switching and zero voltage switching architecture.

The converter's baseplate operating temperature rating is 100°C at 150W, and modules can be connected in parallel.

For further information circle 246 on the reader service coupon or contact Powerbox Australia, 4 Beaumont Road, Mt Kuring-gai 2080; phone (02) 9457 2200, email address sales@powerbox.com.au.

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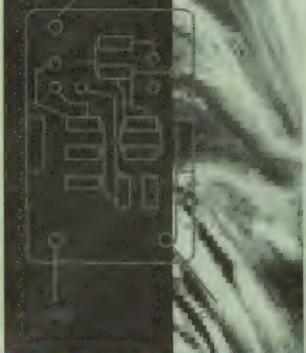
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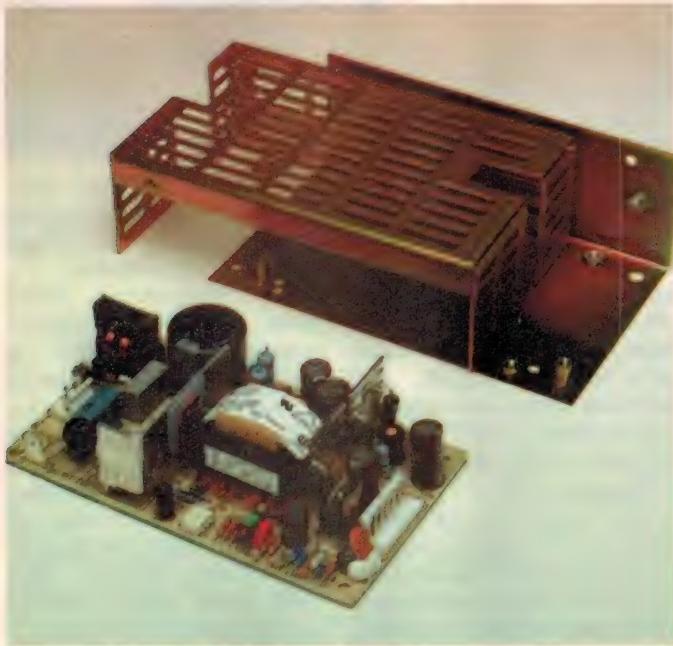
The OZtherm F312 Phase Angle and F412 Fast Cycle power controllers with Crydom SSR's offer low cost power control upto 100 amperes. Current limit and reduced voltage starting options are available. OZtherms digital power controllers are available upto 1100 amperes per phase.

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Power supply enclosures

Vented metal enclosures are now available for the Computer Products 25W and 40W NFS and NAL series



of power supplies. These supplies measure 127 x 76mm and the enclosures measure 160 x 47 x 8.7mm. Input and output cable assemblies are also available.

For further information circle 245 on the reader service coupon or contact Amtex Electronics, 2A Angas Street, Meadowbank 2114; phone (02) 9809 5022.

Rugged photoelectric sensors

Banner Engineering Corp has announced a new series of ruggedised photoelectric sensors, designed for severe environmental conditions. The devices operate from 10 to 30V DC and feature a diecast zinc alloy housing, with the electronics encapsulated in solid epoxy. They also have ruggedised input and output circuitry to protect against transients and reverse polarity.



They come in four sensing modes: opposed mode (through beam or beam break) for a range of 10m; polarised retro-reflective mode for distances to 3m; diffuse (proximity) mode with a range of 400m; and a high-speed fibre optic version.

For further information circle 247 on the reader service coupon or contact Micromax P/L, 307 Keira Street, Wollongong 2500.

Thin-film resistors rival leaded equivalents

A new range of thin-film resistors from Philips is claimed to be able to handle the same pulse power as leaded resistors.

The new PRC202 series is manufactured using a technology Philips developed for its precision metal film resistors, and is said to have significantly higher current densities than equivalent thick-film resistors.

The resistors come in values ranging from 0.1Ω to 100Ω with a tolerance to +/-1%, and can be placed by all standard surface mount assembly machines.

For further information circle 242 on the reader service coupon or contact Philips Test & Measurement, 34 Waterloo Road, North Ryde 2113; phone (02) 9888 0477.

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Tiny power supplies



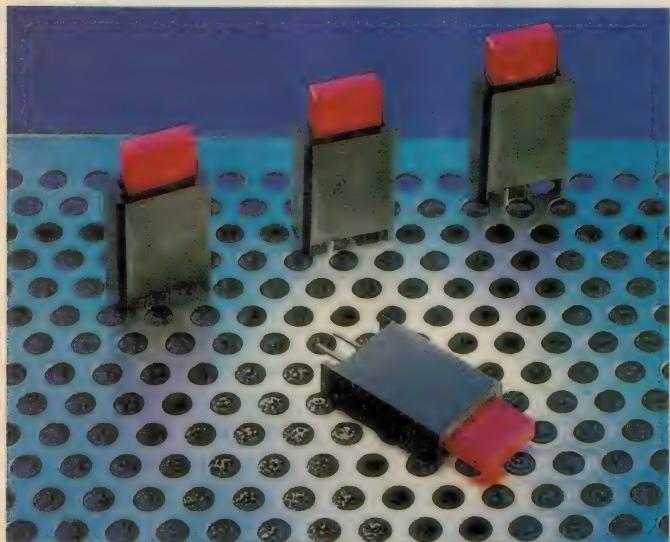
The new NLP40 and NLP65 are 40W and 65W switching power supplies from Computer Products, claimed to be the world's smallest. The NLP40 measures 106 x 63.5 x 29mm, and the NLP65 is 127 x 76 x 32mm. The supplies also have power factor correction and meet all relevant EMI emission and immunity standards.

The supplies are available with a single output (5, 12, 15, 24 and 48V), or dual and triple output configurations. With 20cfm of fan cooling, the maximum power outputs are boosted to 50W and 75W respectively.

For further information circle 248 on the reader service coupon or contact Amtex Electronics, 2A Angas Street, Meadowbank 2114; phone (02) 9809 5022.

Rectangular LED indicator

US-based Dialight Corporation has released a circuit board indicator that features a 2.5 x 7mm rectangular shaped LED with a 50° viewing angle. The device is available with red, green or yellow LEDs with a light output of 5mcd at 20mA. The housing helps resist shock and vibration and has stand-offs that facilitate board cleaning.



For further information, contact Ken Benditt, Dialight Corporation, 1913 Atlantic Avenue, Manasquan, NJ 08736; phone (908) 223 9400, fax (908) 223 8788. ♦

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Average	50 Hz-50 kHz	±(0.5% + 4)	

Function	Range	Best Accuracy	Resolution
Adc	320µA-10A	±(0.05%+15)	0.01 nA
Aac	320µA-10A	±(0.75%+10)	0.1 nA
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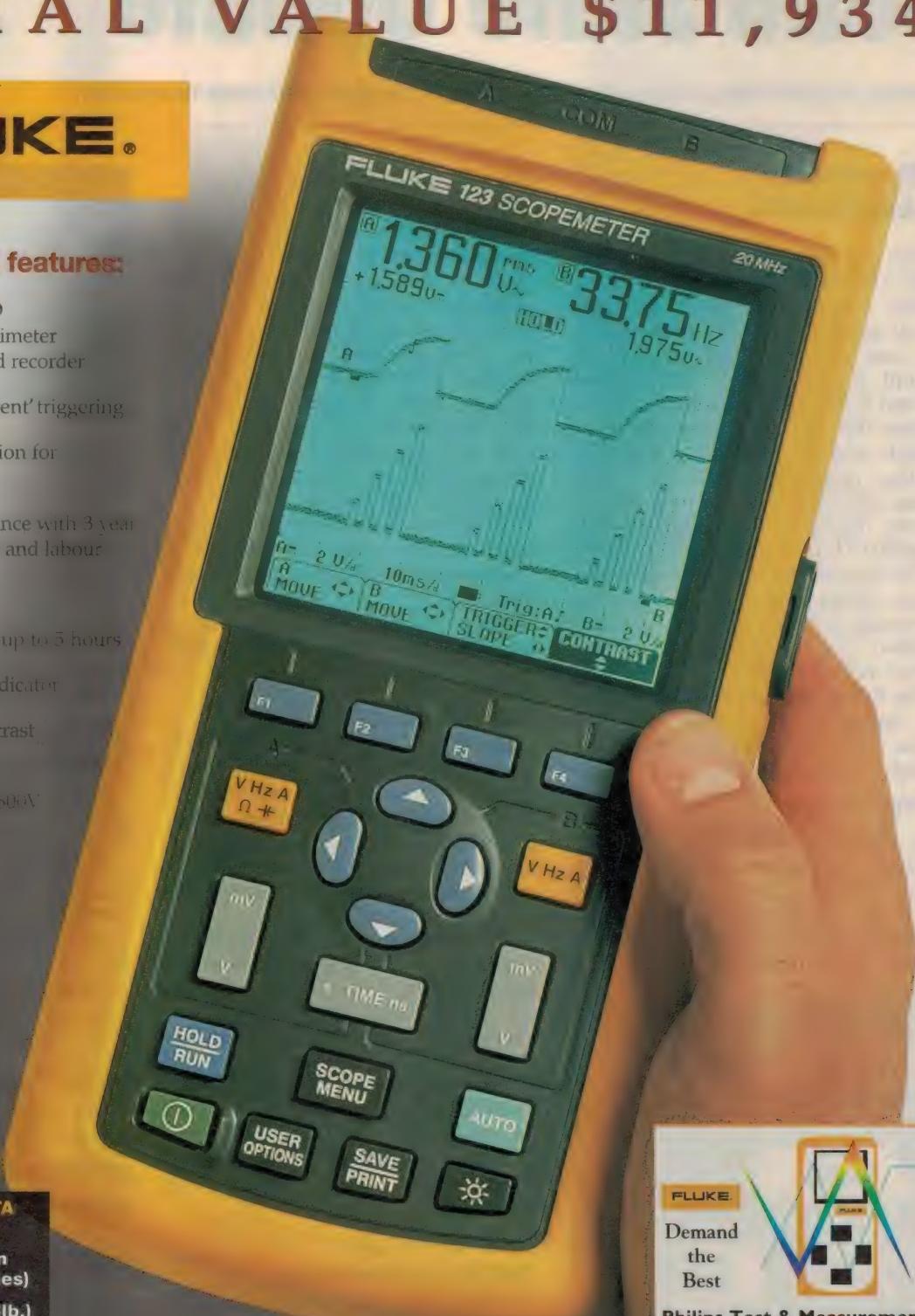
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Weight: 1.2kg (2.5lb.)



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CONDITIONS OF ENTRY: The competition is open to Australian Residents, authorising a city or town council to enter, to Federal, State or Territory residents, on the 22.07.97. Entries received after the closing date will not be accepted. Employees of Philips Electronics Group, Philips' direct suppliers and their immediate agents eligible to enter. 2. Prizes are not transferable or exchangeable and will not convert to cash. 3. The judges decisions are final and binding. 4. Total value of prizes into. 4. The competition commences on the 23.04.97 and closes last mail on the 22.07.97. 5. The draw is at the promoters premises, Federal Publishing Ltd, Bourke Rd Alexandria on 27.07.97 (a second chance draw will be held on the 27.10.97) and the winners will be announced in the 24-09-97 issue of the *Electronics Australia* on sale the 24.09.97 and notified by mail. 6. The prize is one of six Fluke 123 Scope meters valued at \$1,193. Total prize value is \$6,954. 7. The promoter is Federal Publishing Company Pty Ltd 180 Bourke RD Alexandria NSW 2015. 8. All entries become the property of the Federal Publishing Company, the promoter, and may be used for future marketing purposes. NSW Permit No. TC97/Pending; ACT Permit No. TC97/Permit No. TMI/97/Pending. NT permit No TC97/Pending. SA permit no. SA/pending.

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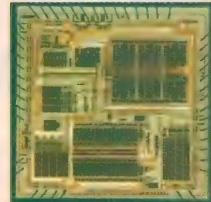
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A/D converter subsystem ICs

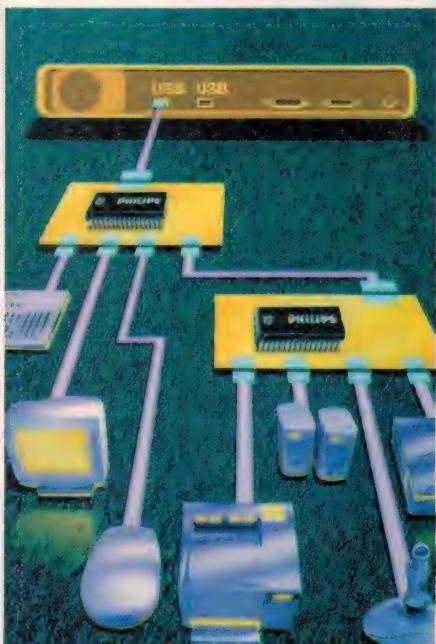
The Analogic ADC4320, ADC4322 and ADC4325 are complete 16-bit 1MHz, 2MHz and 500kHz A/D converter subsystems with a built-in sample and hold amplifier in a 46-pin hybrid package. They are designed around a two-pass, sub-ranging architecture that integrates a low distortion sample and hold amplifier, precision voltage reference, ultra-stable 16-bit linear reference D/A converter, all necessary timing circuitry, and tri-state CMOS/TTL compatible output lines.

The devices have pin-programmable input voltage ranges and suit applications such as ATE, digital oscilloscopes, medical imaging, radar, sonar and analytical instrumentation.

For further information circle 272 on the reader service coupon or contact Obiat, PO Box 37, Beaconsfield 2014; phone (02) 9698 4111.

Transceiver for USB standard

Philips has announced its first USB transceiver chip, an essential building block in implementing the new universal serial bus (USB) standard. The transceiver, the PDIUSBP11, can be used



with any peripheral or host device.

The USB standard has been defined by a group of PC and telephone industry leaders and is claimed to make it easier to set up and use computer peripherals, as they will be correctly detected and configured automatically as soon as they are physically attached. With USB, new peripheral devices, many of them multimedia, will become available to PC users. USB will also enable easy PBX and digital telephone connectivity without specialised add-in cards.

For further information circle 271 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479. (Philips Internet home page is at <http://www.semiconductors.philips.com>)

IC for phone speech transmission

The new TEA1112 and TEA1113 speech/transmission circuits from Philips are claimed to make it easier to achieve compliance to EMC regulation by ensuring telephones are immune to interference from RF sources such as mobile phones, electronic lighting ballasts and wireless LANs.

The chips feature on-chip default settings for microphone gain, receiver gain and AGC, and have on-chip switching for DTMF dial-tone insertion and microphone muting. The TEA1112 also allows secrecy or hands-free speakerphone functions to be implemented.

For further information circle 274 on the reader service coupon or contact Philips Components, 34 Waterloo Road, North Ryde 2113; phone (02) 9805 4479.

New 3V 16-bit CMOS logic devices

Motorola has added five new 16-bit devices to its LCX low voltage CMOS family, increasing it to over 20 devices. The new devices are for memory address driving and TTL level bus-oriented buffering. As with all products in the family, the new devices have 5V tolerant inputs and outputs that enable transition from 5V to mixed 3V/5V systems or to pure 3V systems.

The LCX family improves system



performance by reducing dynamic power consumption. It also simplifies the use of mixed voltage technologies, and expedites development of low voltage systems. Other features include low switching noise and fast switching speeds.

For further information circle 273 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

4-8GHz YIG-based frequency synthesiser

Miteq has introduced the YTS series of 4-8GHz YIG-based frequency synthesisers, suitable for broadband operation with custom design options. Features include a frequency step size of 500Hz, output power of +13dBm, +2dB maximum output power variation, 15dBc harmonics and a load VSWR (all phases) of 1.5:1. Tuning voltage is between 2 - 10V.

For further information circle 275 on the reader service coupon or contact Electronic Development Sales, Unit 2A, 11-13 Orion Road, Lane Cove 2066; phone (02) 9418 6999.

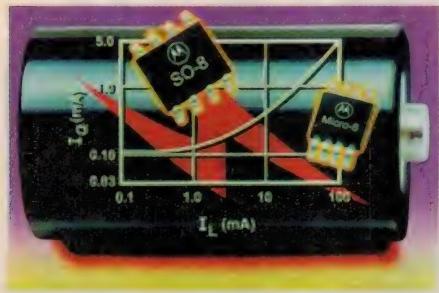
900MHz GaAs power amplifier



Motorola has announced a new RF integrated two-stage power amplifier for use in high efficiency analog cellular applications. The MRFIC0912 900MHz gallium arsenide (GaAs) device uses Motorola's planar refractory gate, self-aligned GaAs MESFET IC process. It operates over the frequency range of 800MHz to 1000MHz with a 470mA maximum supply current at an output power of 30.8dBm. It operates with a supply voltage of 4.6V and has a small signal gain of 23.8dB.

For further information circle 276 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

Regulators have on-off control



Motorola has introduced a family of micropower low dropout voltage regulators, the MC33264 series. The devices have seven fixed output voltages ranging from 2.8V to 5.0V, with internal current and thermal limiting protection. They feature an input-to-output voltage differential of 10mV at 1mA to 120mV at 50mA, and can supply an output current up to 100mA.

The regulators have a standby quiescent current of 0.1uA and a normal quiescent current of 100mA. They also have logic level inputs to turn the output on or off, giving control to extend battery life in portable equipment.

For further information circle 277 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

Power factor control IC

Siemens has developed a new power factor control (PFC) IC for electronic ballasts and switch-mode power supplies. The IC includes overvoltage protection, internal filter and starting circuit and a wide operating temperature range.

The new chip, designated TDA 4862 is also suitable as a PFC for electronic

ballasts in fluorescent lamps, for PC and monitor power supplies. As a harmonic filter it controls a step-up converter over an input range of 90V to 270V without switchover and with a power factor of 0.98. It has a maximum current consumption of 8mA.

For further information circle 278 on the reader service coupon or contact Siemens Ltd, 544 Church Street, Richmond 3121; phone (03) 9420 7609.

16-bit 250kHz ADC

Burr-Brown's new ADS7815 is a complete 16-bit, 250kHz sampling CMOS analog-to-digital converter claimed to offer excellent AC performance. The design includes a 16-bit capacitor-based SAR (successive-approximation register) A/D with sample and hold, precision reference, internal clock, interface for microprocessor use, and three-state output drivers. It has a +/-2.5V input range.

Key specifications include: full parallel data output, 250mW max power dissipation, 84dB min SINAD, 96dB min SFDR with 100kHz input, and internal or external reference.

For further information circle 279 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

Evaluation board for waveform generator ICs

PWMDEMO is an evaluation board from GEC Plessey Semiconductors, for evaluating the SA828/838 pulse width modulation (PWM) waveform generator ICs. It has everything needed to develop a low-cost controller for variable speed three-phase induction motor drives. It also supports single phase applications such as uninterruptible power supplies.

Based on an 8032 microcontroller, the board includes memory, keypad and LCD display, plus sockets to accept all variants of the SA828/838 ICs and a prototyping area for users to include application dependent interface circuitry. PWMDEMO can also be connected to a PC for programming.

For further information circle 280 on the reader service coupon or contact GEC Electronics Division, Unit 1, 38 South Street, Rydalmerle 2116; phone (02) 9638 1888.

Instrumentation amp IC

The new INA126 from Burr-Brown is a low cost, precision instrumentation amplifier designed for accurate, low noise differential signal acquisition. It has a 175uA quiescent current and an

operating voltage range of +/-1.35V to +/-18V. Applications include industrial sensors, analytical and scientific instrumentation, medical diagnostic instruments, data acquisition systems and portable, battery operated systems.

The gain can be set from five to 10,000 using a single external resistor and its laser trimmed input circuitry gives a 250uV max offset voltage, a low offset voltage drift, and 83dB common-mode rejection.

For further information circle 281 on the reader service coupon or contact Kenelec, 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700.

Fast charger IC

Motorola has introduced the MC33340, a battery fast charge controller IC specifically for fast charging nickel-cadmium and nickel-metal hydride batteries using negative slope voltage detection. The device ensures accurate charge termination by momentarily interrupting the charge current for voltage sampling. The IC also supports secondary charge termination methods of either programma-



ble time or temperature limits.

Protective features include battery over- and under-voltage detection, latched over temperature detection, and power supply input under voltage lockout.

For further information circle 282 on the reader service coupon or contact Motorola Australia, 673 Boronia Road, Wantirna 3152; phone (03) 9887 0711.

Kit simplifies wireless LAN design



Harris Semiconductor has released an evaluation kit which simplifies the design of wireless LAN systems. Particularly of interest to Australian manufacturers will be support of the IEEE 802.11 wireless LAN standard, which will allow local companies to quickly design and build network cards conforming to the international wireless LAN standard.

The kit simplifies the design of direct-sequence spread-spectrum (DSSS) wireless products for the 2.4-GHz band, by providing an evaluation platform that lets RF designers perform lab measurements on real transceivers based on the PRISM chipset. With this chipset, manufacturers can

build 2Mb/s digital radios on PCMCIA cards with ranges of over 100 metres indoors and 1km outdoors. In addition to wireless LANs, PRISM chipset applications include bar-code scanners, security systems, point-of-sale terminals, manufacturing control systems, printer sharing, and audio systems.

The PRISM chipset evaluation kit consists of two pre-assembled PCMCIA cards, the PRISM chipset, an industry standard media access controller, RF connectors, PCMCIA extender cards, licences, diagnostics software for measurement and display of packet error rate and throughput, and documentation.

Rugged 600V IGBT

Harris Semiconductor has released rugged versions of its ultrafast switching (UFS) 600 volt, 20 amp IGBTs (insulated gate bipolar transistors). The new devices allow motor-controller designers to replace conventional power transistors with IGBTs to maximize efficiency (due to the lower conduction



High current driver amp for xDSL use

Burr-Brown's new DRV1100 is a low power, low cost differential line driver designed for low harmonic distortion at the high powers required for driving high speed digital subscriber lines. It operates on a single +5V supply and delivers 230mA peak output current. The DRV1100 is claimed to be ideal for xDSL systems such as ADSL, RADSL, HDSL, and other twisted-pair line driver applications that require up to 17dBm applied to the line.

The DRV1100's differential output structure allows it to drive a floating load such as a transformer with a peak-to-peak voltage swing greater than the power supply voltage. The differential output voltage swing of the DRV1100 is twice that of a single ended output device such as a normal op-amp. Thus, it can drive a low impedance 15Ω load with a 6Vp-p signal, and a higher impedance 1000Ω load with a 9.5Vp-p signal.

Key DRV1100 specifications include 5MHz bandwidth, 3V/V fixed differential gain and 11mA quiescent current.

For additional information circle 284 on the reader service card or contact Burr-Brown distributor Kenelec, at 2 Apollo Court, Blackburn 3130; phone (03) 9878 2700 or fax (03) 9878 0824.



The evaluation kits are available from Harris distributor BBS Electronics at a price of \$1750 (ex tax). For further information circle 283

on the reader service card or contact BBS at Unit 24, 5-7 Anella Avenue, Castle Hill 2154; phone (02) 9894 5244 or fax (02) 9894 5266.

losses) without redesigning their present short-circuit protection circuits.

The HGT1S20N60C3R (TO-262AA package), HGT1S20N60C3RS (surface-mount TO-263AB), HGTG20N60C3R (TO247), and HGTP20N60C3R (TO-220AB) are rated for 600V collector-emitter breakdown voltage and 20A continuous collector current at 110°C. Short-circuit withstand time is 10μs, the maximum for any IGBT, at 440V and 150°C. Harris rates short-circuit withstand time (SCWT) at 440V rather than 360V, as some competing IGBT manufacturers do.

An important new feature of the Harris IGBTs is the specification of dV/dt for turn-on and turn-off voltages (1.3, and 7.0V/ns), a characteristic generally not offered by competitors. In motor control applications, excessive dV/dt can damage motor end-windings, and controller manufacturers are becoming increasingly concerned about this specification.

For further information circle 285 on the reader service card or contact BBS Electronics at Unit 24, 5-7 Anella Avenue, Castle Hill 2154; phone (02) 9894 5244 or fax (02) 9894 5266. ♦

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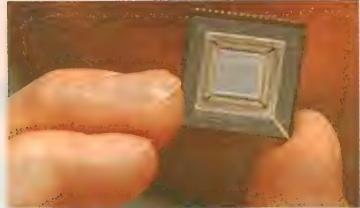
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Silicon Valley NEWSLETTER



3Com buys US Robotics for \$7.3 billion!

The largest corporate merger in Silicon Valley history is taking place, as Santa Clara network communications company 3Com is to pay a whopping US\$7.3 billion for US Robotics, now the world's largest PC modem manufacturer.

With the acquisition, 3Com signals its intention to become the largest vendor in the computer networking market, displacing industry leader Cisco Systems. The combined 3Com/US Robotics company will have annual revenues in excess of US\$4.4 billion and a workforce of more than 12,000 people. The new company will operate under the 3Com banner. Company chairman Eric Benhamou said suggested names such as 4Com and USCom were rejected, because "we were not going to waste management time trying to choose a new name."

The merger is an all-stock deal, without any premium for US Robotics shareholders, who will receive 3Com stock equal to the value of their US Robotics stock. 3Com is betting shareholders will accept the deal because the combined organization can be expected to do better than if they were to continue to operate as independents.

Benhamou said he will continue to head the firm as chairman and chief executive officer. Most other 3Com executives will retain their positions or receive expanded responsibilities. US Robotics' highest ranking officer, Casey Cowell, who also founded the company in 1977, will become vice chairman, a largely ceremonial job without day-to-day responsibilities. "3Com will take the clear lead", Benhamou said.

The sale of US Robotics, which has a 25% share of the PC modem market, came a week after the company started shipping its 56 kilobit-based PC modems, for which a US\$5 billion annual market is expected to develop over the next few years.

DVD players finally hit US store shelves

Six months behind schedule, the first Digital Video Disk (DVD) movie players shipped in late February to major US consumer electronics retail chains, with Japan's Pioneer leading the charge. The first DVDs, however, come with a stiff premium for consumers who wanted to be the first on the block with the new gadget.

Pioneer's Elite DVL-90 carried a suggested retail price of US\$1750, about \$1000 more than the average price that was expected for the first generation of DVDs. But industry analysts expect DVD prices to drop quickly below the \$800 level as soon as other major suppliers begin shipping in volume.

Toshiba, for example, was expected to enter the US DVD market in April with a \$600 machine. Later in the spring, Pioneer will add lower-end models that will retail in the \$600-\$900 range as well.

At the recent CES Motorola displayed its innovative PageWriter, a two-way pager that allows for wireless communications with Internet e-mail addresses, fax machines and other pagers. It has 1.25MB of memory (1MB of flash RAM) and is expected to be available in the US by the middle of the year for around \$400.

Around May, Sony will release a \$1000 DVD player that was shown at the recent Consumer Electronics Show. "DVD is going to be embraced by early adopters, and they are very sophisticated users", according to Carl Yankowski, president of Sony Electronics.

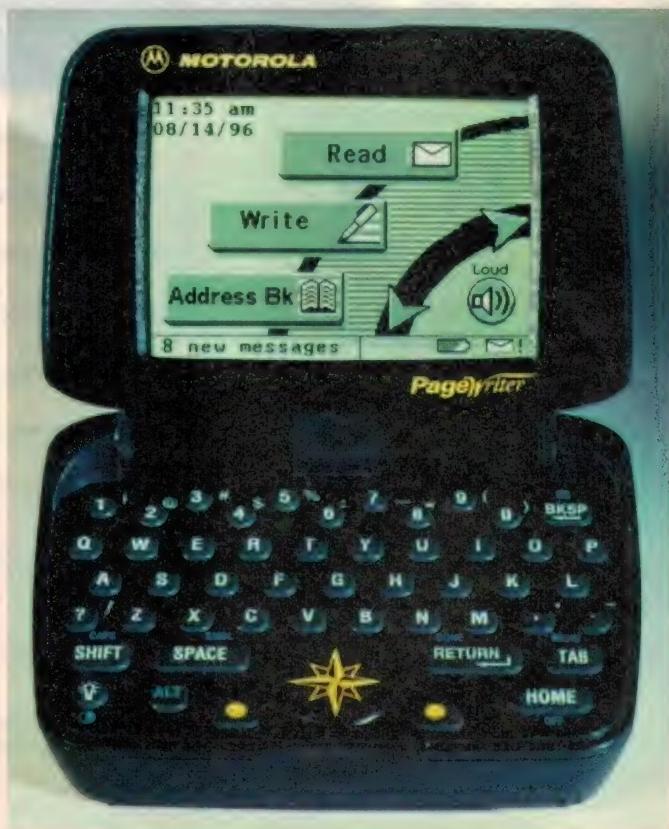
All of the initial machines are limited to playing movies on television sets. The first machines with PC compatibility are not expected until the Fall. DVDs that will work with both PCs and TVs are scheduled for introduction in 1998.

Along with the DVD movie players, Hollywood studios have geared up to deliver the first of thousands of titles. Time Warner's Warner Home Video unit planned to have 40 DVD movies, including *Twister* and *Bridges of Madison County* in stores by late March at a price of US\$25. Metro-Goldwyn-Mayer (MGM) will also have DVD titles such as *The Birdcage* on the market in March, through WHV. Sony's Columbia Tristar Home Video unit was expected to begin selling titles like *In the Line of Fire* and *Jumanji* by the end of April.

C-Cube chip to lower DVD prices

Prices of digital video disk (DVD) players may soon fall rapidly, as manufacturers take advantage of an advanced new DVD IC just launched by C-Cube.

The chip combines eight major DVD functions onto a single IC, vastly reducing overall system production costs. As a



result, DVD players could sell below US\$500 by the end of this year — hundreds less than the \$600-1500 prices the first models are currently fetching in US retail stores.

Valley's job market now booming

Times are good in Silicon Valley. By 1999 some 881,000 people were expected to be employed in the Valley's Santa Clara County, according to California's State Employment Department. That prediction was made in March 1996. But the explosive growth of the Valley's high-tech industries have shattered all previous predictions, and today more than 891,000 people are already working in the county.

During 1996, a record 38,000 new jobs were created in the county, which stretches from Palo Alto to San Jose in the southern part of San Francisco Bay. A recount of employment numbers added another 15,000 previously undocumented jobs. Unemployment in the Valley hit a record low of just 3%. Some 5000 of the new jobs in 1996 were created by newly formed software and Internet start-ups alone.

Overall, California gained 400,000 new jobs in 1996, the best performance since the economic boom of the mid 1980s. Statewide unemployment rates are around 6%. That is less than half when President Clinton took office in 1992, amidst massive lay-offs in the state's defence and aerospace industries and countless base closings during the wind-down of the military in the early post-Cold War years.

Hostile takeover bid for head maker

Hostile takeovers in the high-tech industry are rare, especially in Silicon Valley, and have never taken place in the volatile disk drive industry. However Applied Magnetics has announced it is making a hostile bid to acquire Read-Rite, a Valley-based major supplier of disk drive recording heads. If successful, Applied Magnetics will pay some US\$1.7 billion for 60% of the outstanding shares of Read-Rite, a 15% premium over the value of Read-Rite stock prior to the announcement.

The takeover would also be the first in which one corporate fish is trying to swallow a much larger one. Applied Magnetics had 1996 sales of just US\$344 million, compared to the \$991 million which Read-Rite grossed in its most recent fiscal year. However, Read-Rite lost US\$43 million while its suitor made more than \$32 million.

Pixar's 10-year deal with Disney

After a long dry spell, Steve Jobs is on a headline roll. Amidst front-page rumours he may be planning a leverage buy-out of the struggling Apple Computer company he co-founded in 1976, Jobs signed a lucrative deal for his Pixar computer animation firm with the Walt Disney company.

If that wasn't enough publicity for one week, Jobs also found his picture featured prominently in the national media covering the controversy over President Clinton letting prominent Americans stay the night in the famous Lincoln Bedroom at the White House, in return for generous donations to his Democratic party. Jobs donated US\$150,000 for the one-night stay, which included breakfast with the President.

Under the terms of the 10-year deal with Disney, Pixar will produce at least five new full-length computer animated feature films and related follow-on products.

In 1995, Pixar produced the hit movie *Toy Story* for Disney using the company's proprietary computer-based animation technology. *Toy Story* has so far grossed more than US\$350 million in box office and video sales.

Disney chairman Michael Eisner said Pixar's technology vastly reduces the cost and effort required to make full-length animated feature films. Only about 150 people are needed to produce such movies, against 500 to 700 using more conventional techniques.

Disney will pay Pixar US\$15 million for one million of its shares, with an option to buy an additional 1.5 million shares at a later date. That would give Disney a 5% stake in Pixar. Disney and Pixar will share the cost of future film productions on a 50-50 basis. In return, Pixar will also reap in half of the projects' profits, including those from the sale of videos, toys and other merchandise. Under a previous agreement signed in 1991, Pixar received only 10-15% of the profits.

Jobs said Pixar is unique in the animation industry. "Everybody has tried to break into the animation market since Snow White was released in 1937. So far, only two companies have ever produced a blockbuster production grossing more than \$100 million — Disney and Pixar. We decided that if we were not going to distribute our own movies, we might as well get the best partner, and that is Disney."

The combined company would have an initial workforce of 28,000 people, although layoffs would probably be inevitable when Applied eliminates overlapping positions and streamlines Read-Rite's operations.

Applied Magnetics chairman Craig Crisman, a veteran turnaround specialist, said the combination of the two organizations will create a company that will be able to compete effectively with Seagate and IBM, which have been aggressively expanding their disk drive operations and manufacture their own heads. "You need more resources to compete against players like those."

Digital cameras may grow only slowly

Dataquest has forecast that the worldwide digital still camera market will reach just 5.9 million units by 2000, creating a US\$12 billion market — including \$463 million in digital still-camera semiconductor revenue.

This year shipments are predicted to reach 1.9 million units, with an average selling price for manufacturers of US\$246 in 1997 and \$177 by 2000. Those numbers, however, indicate the digital camera market may not become the next bonanza consumer electronics field consumer electronics firms have been hoping for.

"The major reason these cameras will not replace traditional film cameras by

2000 is price", Dataquest said — adding that consumer purchases will increase when the cameras drop into a "more affordable price range".

DSP market will triple, says TI

Texas Instruments' vice chairman Pat Weber has issued a good news/bad news forecast for two vital chip markets, saying the DRAM memory market will remain very volatile while sales of digital signal processors will continue to boom for the next several years.

Weber said the recent modest increases in DRAM prices should not be mistaken for a recovering memory market. The increases have been between 50 cents and \$1 per 16-megabit chip. "It's difficult to tell whether the increases are temporary or permanent", Weber said.

Overall, however, demand for DRAMs remains strong. "The unanswered question is how much capacity will remain on line", Weber said, predicting that the industry appears to be in a shake-out period with some Asian producers apparently cutting production.

Meanwhile, Weber said the market for DSP chips is expected to triple in the next three years to more than US\$12 billion by the year 2000. The growth is driven by the rapid expansion of DSP-powered markets, such as cellular-phone systems and other communications equipment. ♦

VISIO TECHNICAL V4.1

Back in 1992 Visio Corp, a company founded by the developers of Aldus PageMaker, released the Visio V1.0 drawing package. This has since evolved into version 4.0 and a new product, Visio Technical V4.1, has now been developed specifically to cover the intricacies of technical drawing. We decided to put Visio Technical through its paces for the benefit of our readers, and were mightily impressed with what we found.

by GRAHAM CATTLEY

People in almost every industry need at some stage to produce accurate technical drawings, and these are usually produced with one of two types of drawing packages: either vector based drawing software like CorelDraw!, or an advanced CAD package such as AutoCAD. Both of these types of packages work well up to a point, but they both have shortcomings in terms of actually producing your drawing. With vector based packages there is usually just too much flexibility in layout and design, making it hard to keep a consistent look and style to your drawings.

CAD packages, on the other hand, benefit from their ability to deal with objects rather than points and lines, and also support advanced features to such as automatic dimensioning. However, CAD packages are notoriously difficult things to drive, and are often so cumbersome that you tend to lose track of the job in hand.

Enter Visio Technical

So where does Visio Technical fit in with these other drawing programs? Well, somewhere in between — it provides a full range of vector drawing tools (lines, circles etc.), as well as a full compliment of CAD features as well.

The review copy of Visio Technical V4.1 came in both Windows 3.xx and Windows 95/NT versions, on a CD ROM or 13 floppies. It also came with a 210-page user manual as well as a 420-page Visio development manual.

The review copy also included a large format (A4) spiral bound evaluation guide that contained detailed step-by-step instructions for creating and modifying drawings, but I don't think that this is included as part of the standard package.

After installing Visio Technical on a 150MHz Pentium with 32MB RAM and Win95, I dutifully followed my policy in reviewing software, and hid the manuals. And, I'm happy to say, I *almost* didn't need to refer to them at all during the review period. I found Visio Technical to be one of the friendliest

pieces of software I have ever had the pleasure to review.

The one aspect of Visio Technical that stands out from all the others is that it seems to have been designed to give the users what they want, instead of tripping them up on technicalities. The feeling I got while using Visio was 'at last, somebody got it right'.

Visio's ease of use means that you forget about learning how to drive the software, and instead can concentrate on producing your drawing. There are several nice touches to the Visio interface — little things, like the screen zooming in when editing text so you can see what you are typing, and then zooming back out when you have finished...

The two 'speed bars' running along the top of the screen are modal, reconfiguring themselves as you work, giving you a pretty good idea of the options open to you at any time, and the buttons themselves even sport intelligently designed icons, so you don't have to try to remember what each one does.

SmartShapes

The whole concept of Visio Technical (in fact all of Visio's products), is based on what Visio call 'SmartShapes'. These are ready-made shapes that can be dragged from a 'Stencil Sheet' into the main drawing. Once there, each shape can be moved and stretched into the desired shape and size. A very basic example of the flexibility of a SmartShape would be the 'arrow'. This shape starts off as a fairly conventional arrow, but once it is dragged onto the drawing, a number of handles appear which can be used to set the point angle, tail length, overall length etc.

Visio Technical comes with over 2000 SmartShapes, grouped in over a dozen categories that include networks and communications; electronic, electrical and mechanical engineering; Home planning and building services; and fluid power, to name a few. The 'smart' part of SmartShapes is that a shape can have various properties, and each prop-

erty can be a function of another property of the same object. For example, the SmartShape for a hex-head bolt can be stretched along its length, resulting in a longer bolt — but if stretched laterally (that is, increasing the bolt's diameter), the bolt's head is automatically resized to keep it in its proper proportion.

On top of all this, each shape contains extensive help on which parameters can be changed, and how each change will effect other parameters within the same shape.

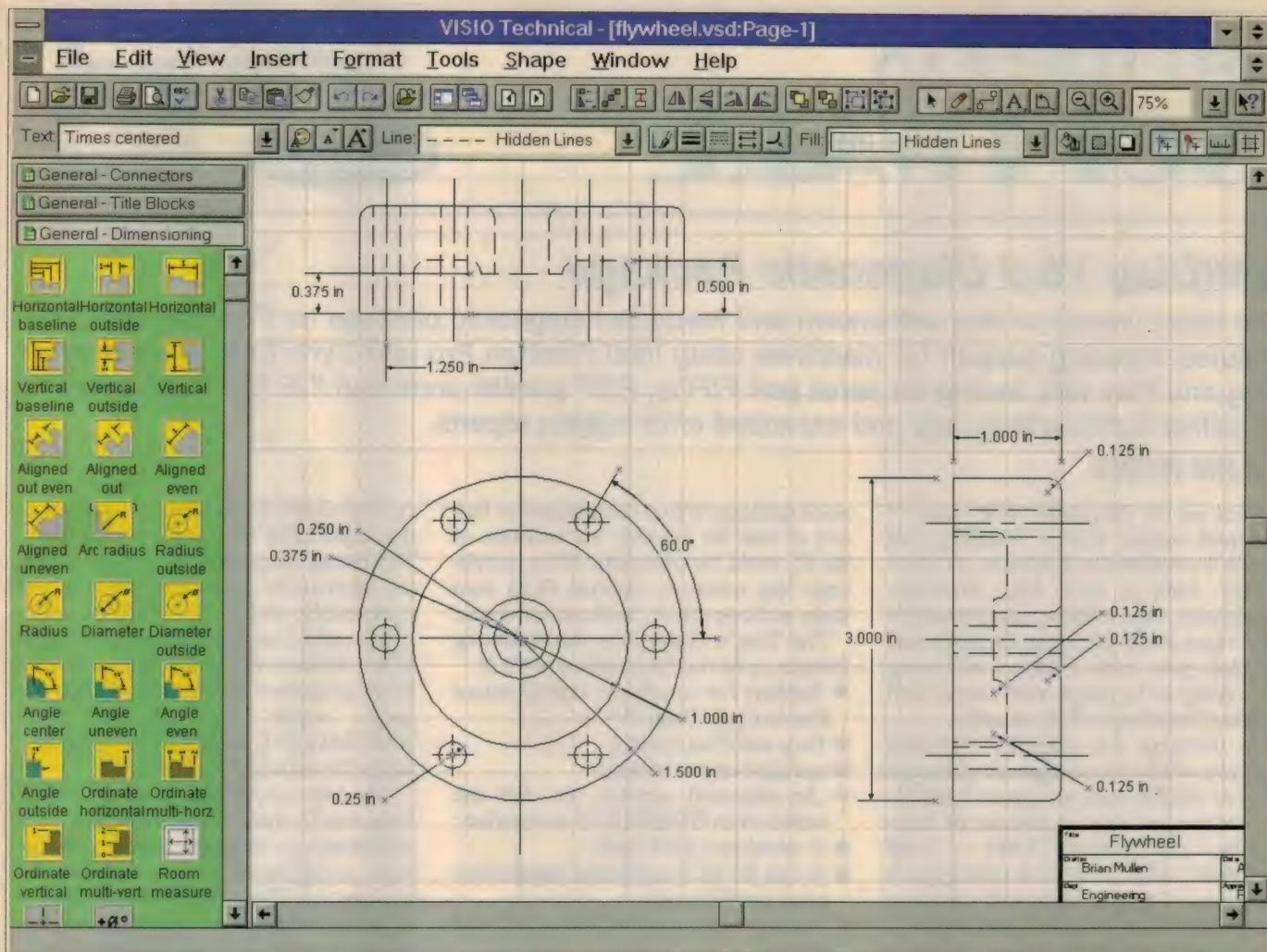
Quick on the draw

Once I'd used Visio Technical for a number of weeks, I found that by using even the most basic of the supplied shapes, it is possible to have your drawing up and on the screen in a matter of *seconds*. For example I just stopped writing this review and fired up Visio Technical; within one and a half minutes I was printing a seven step programmer's flowchart containing terminators, a yes/no conditional block (with labeled branches) and four operational procedures. This was just a matter of opening a flowchart stencil sheet, and dragging the required shapes onto the work area.

Instead of using the line tool to connect each of the shapes, I decided to use the Universal Connector. This is another SmartShape which exhibits a degree of intelligence in that it will maintain nice, right angle lines between the two connected objects — perfect for flowcharts.

Make your own

One rather unsung feature of Visio Technical is that you can design your own SmartShapes to use in your drawings. Visio have obviously gone to great lengths to provide shapes for a huge array of commercial and industrial equipment as well as the more mundane — you'll find a whole raft of shapes from an IBM 6150 RT in the IBM equipment stencil sheet, all the way down to a flat washer in the fasteners stencil. But if you need a shape



In the above screen shot, you can see on the left one of the drawing's three stencil sheets, open to show some of the many dimensioning SmartShapes available. The speed bars at the top of the screen configure themselves to suit the current editing mode.

for a particular piece of equipment, or just a simple outline, it's easy enough to make your own.

Well, it is easy once you know how. Just about the only time that I needed to look in the manual was to find out how to actually get into shape edit mode; this seems to be one aspect of Visio Technical that Visio aren't pushing all that hard.

It is easy to see why, though: a catalogue included in the package lists around 20 ready made libraries, covering such diverse fields as chemistry, marketing, and even crime scene reporting. Each of these add-on libraries contain hundreds of specialised SmartShapes, as I found when Visio sent me the Advanced Electrical Engineering package.

It didn't come with very much documentation, but I followed the simple installations, and was pleasantly surprised to find that I now had over 300 electronic component symbols and shapes sorted into a dozen different categories.

I was a little taken aback in finding pentodes and tetrodes mixed in with the enhancement mode MOSFETs, and a bit worried about having to wade through long lines of little-used components to find the one I wanted. But after another quick check with the manual I discovered that you can create your own blank stencil sheet, and simply drag any shapes you want into it. This means that you can keep a working stencil sheet that contains all the shapes you regularly use, and call it

up each time you start a new drawing.

There isn't space in this review to do Visio Technical full justice. It has the ability to import and export AutoCAD drawings and objects, full OLE 2.0 support, and a multitude of 'Wizards' to help you setup specific types of drawings. One major feature that I haven't touched on is the fact that any aspect of any SmartShape can be linked into an OLE compliant database. This can result in diagrams keeping themselves up to date, as well as having aspects of one drawing reflect changes in another.

To sum it all up then, I'll say that if you need to produce *any* type of technical drawing, go out and buy a copy of Visio Technical; you won't be disappointed.

I'll leave the final word to a visiting relative of mine who uses Visio in his capacity as sales administrator of a very large IT service provider. His reply when I asked of his opinion of Visio Technical? "Unreservedly recommended". ♦

Visio Technical V4.1

Good points: Fast, powerful and easy to use.

Bad points: Couldn't find any.

RRP: \$499 (Extra libraries \$99 each).

Available: Market Source, Level 5, 105 Kippax St., Surry Hills, 2010; phone 1800 625 550, or fax 1800 819 266.

SPOTLIGHT ON SOFTWARE



AMIDiag V5.0 Diagnostic Package

The latest version of this well-known and respected diagnostic package for PCs has additional features including support for machines using Intel Pentium Pro and Cyrix 6x86 processors, a Plug-and-Play test, testing for serial port FIFOs, ECP parallel ports and IDE CD-ROM drives, a simplified scripting language and expanded error logging reports.

by JIM ROWE

Back in the November 1995 issue, I reviewed version 4.50 of AMIDiag and gave it a warm recommendation. As you'd expect from a firm like American Megatrends, with its heavy involvement in IBM-clone BIOS firmware, the diagnostic package gave every evidence of having been designed by people with a sound and intimate knowledge of PC innards.

At the time, for example, AMIDiag was one of the few diagnostic packages to give reliable and unequivocal indication of the presence or absence of functioning Level 2 cache RAM — most important, when there had been quite a few cases of people being sold machines with dummy cache chips, and some of the other diagnostic packages couldn't seem to tell the difference!

Like V4.50, the new version is designed for IBM compatibles (ISA, EISA, PCI, VL-bus or Plug and Play) with 80286 and later processors, and runs under DOS — version 3.0 or later. It also needs at least 512KB of conventional memory. It's basically a system hardware testing and diag-

nosis package, with a comprehensive battery of tests for not only the hardware of the PC itself, but also some of the peripherals like monitors, external SCSI hard disks and tape drives, modems and so on.

The User's Guide lists the following features as having been added to V5.0:

- Support for computers with Pentium Pro or Cyrix 6x86 CPUs;
- Plug and Play testing;
- multiprocessor testing;
- An enhanced memory test that still works when HIMEM.SYS is installed;
- A serial port FIFO test;
- A test for ECP (extended capabilities port) parallel ports;
- Diagnostic tests for IDE CD-ROM drives;
- Tests for all SCSI devices;
- A new, simplified scripting language;
- A modular construction, supported through the new American Megatrends API; and
- Error logging reports including additional detailed system information.

Most of these are fairly self-explanato-

ry, and clearly extend the package's testing capabilities in various useful ways. The change to a modular construction is less obvious or relevant to the user, but presumably makes the package more robust and/or more readily updated. Many of the different functional tests now seem to be performed by separate EXE modules, which are called from AMIDIAG.EXE according to a configuration file called AMITESTS.INI.

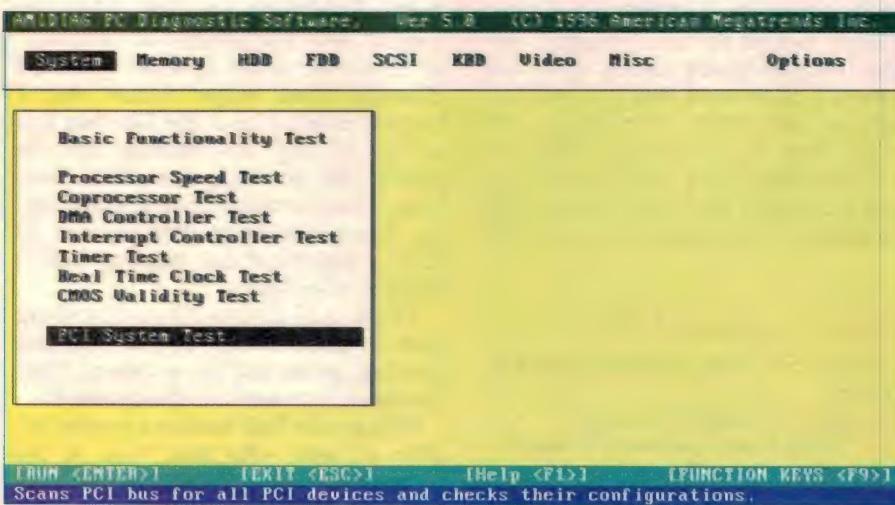
The new scripting language should be welcome to those using AMIDiag in a production environment, along with the more comprehensive error logging and test reports. The earlier versions were a little clumsy in terms of scripting, and this was perhaps the package's weakest area.

Like V4.50 the package comes complete with DB-9 and DB-25 'loopback' plugs for I/O port testing, along with the 138-page User's Guide. In addition to the main AMIDIAG.EXE program there's also SYSINFO.EXE, a very thorough system examination utility.

Trying it out

To try out AMIDiag V5.0 in practice, I installed it on a 90MHz Pentium machine with Award BIOS, 32MB of RAM, 400MB and 800MB IDE hard disks, a Diamond Stealth 64 video card, an IDE CD-ROM drive, a Soundblaster 16 sound card, an Iomega Zip drive hooked up via the Centronics port (along with an HP LaserJet 4MP printer), and an HP ScanJet 4C scanner hooked up via an Adaptec SCSI controller card. Installing it was quite easy and straightforward, from the 3.5" floppy supplied, but as with previous versions there were still the usual complications when I tried to run either AMIDIAG or SYSINFO.

SYSINFO, for example, wouldn't run if you had already booted up the computer in the usual way from the hard disk, using the normal CONFIG.SYS and AUTOEX-



The main screen for AMIDiag V5.0: revamped, and somehow more attractive than previous versions. Some 'greyed out' options were lost in this screen dump.

EC.BAT combination to load the various drivers, etc. All you'd get, if you tried running SYSINFO, was a terse "Unrecoverable Privileged Operation Error" message from EMM386.EXE, with rebooting as the only option. In order to run SYSINFO at all, you had to boot up the machine from a floppy so that EMM386 wasn't operating.

Similar problems occur with AMIDIAG, or more specifically its memory testing module MEMDIAG.EXE — which won't perform many of its memory tests if EMM386.EXE is operating.

The problem with booting up from a plain DOS system disk, on the other hand, is that this doesn't load many of the DOS drivers needed for the system to 'talk' to various devices, or even know that they're present. So booting up in this way certainly allowed SYSINFO to run, but also prevented it from being able to detect the IDE CD-ROM drive, the scanner on the SCSI bus, or the Zip drive (which normally runs under the control of Iomega's nifty little GUEST.EXE driver)...

To use all of the testing facilities of both AMIDIAG and SYSINFO, then, it's really necessary to make up a special booting floppy with a modified CONFIG.SYS and AUTOEXEC.BAT combination able to load most of the device drivers, but not things like EMM386.EXE which cause

conflicts. This involves a fair bit of knowledge regarding the way these systems work, and even then a certain amount of 'try it and see' experimentation.

There's still not much help in this area from the User's Guide itself, but AMI now has its own Web site (www.megatrends.com) which apparently provides convenient access to support.

AMIDIAG's main menu screen has been revamped, and is now somewhat cleaner and more attractive. Once you've booted up your machine from a suitable custom booting floppy, then, it turns out to be quite easy to use — and needless to say, very informative.

My only other (minor) gripe is that my editor's eye spotted a few silly spelling mistakes, in some of the on-screen messages: 'horizontal' and 'available', for example. Still, nobody's perfect!

On the whole, AMIDIAG V5.0 is a very solid diagnostic package, and one that deserves a place in the toolkit of anyone who needs to maintain DOS-based PCs. It's also quite reasonable value for money, at the stated RRP of \$189.

Further information is available from AMI's Australian distributor Tech Star International, of Unit 2, 31 Black Street, Milton (PO Box 259, Paddington) 2064; phone (07) 3367 1444, or fax (07) 3367 1331. ♦

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*See page 115
for details*

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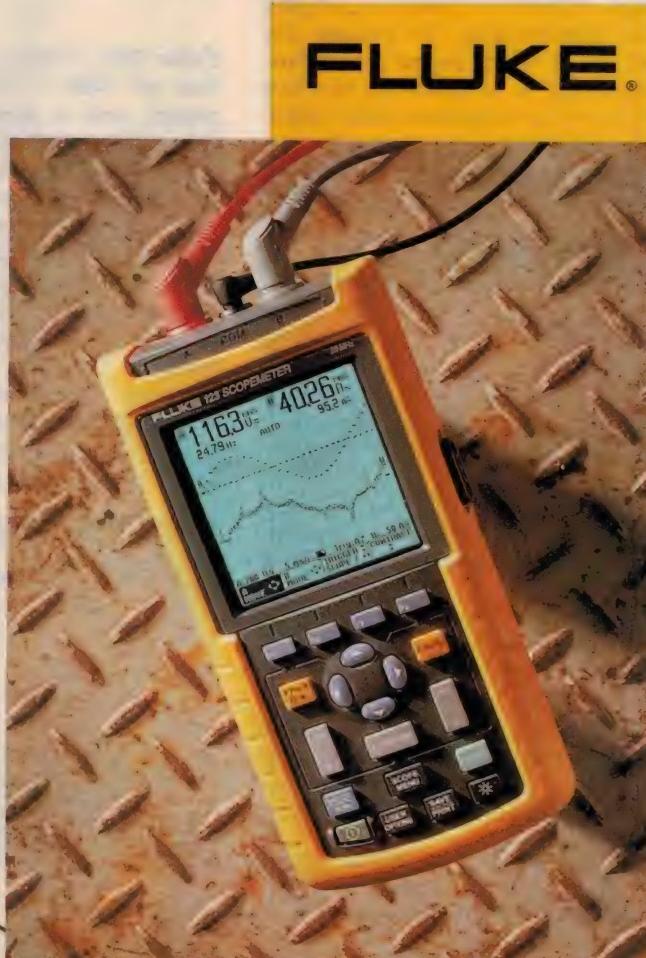
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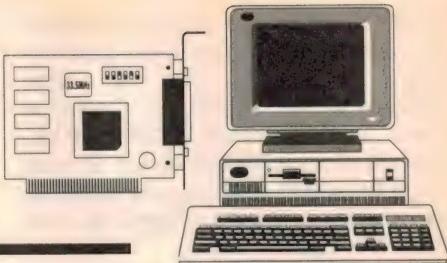
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Computer News and New Products



New range of colour printers...

Epson has released a new range of colour inkjet printers which incorporate a new micro piezo print head, quick dry ink and AcuPhoto half toning. The new piezo print head has more nozzles, which increases the printing speed. However, the new head also has greater control over the amount of ink that's ejected, giving smaller droplets and hence improved resolution. The drop size is half that of the Epson Micro Dot and one third the size of the ink droplets produced by the Epson Stylus Color 500.

The new quick dry ink is claimed to overcome bleed problems, where slow penetration ink tends to bleed into adjacent areas of the paper. The new ink penetrates the paper in 10us, and its reduced drying time cuts down on the amount of bleed. It also has a higher colour concentration, to counter any losses caused by the deeper penetration.

Halftoning is enhanced in the new printers by an improved error diffu-



Clockwise from above: the Epson Stylus Color 800, 400, 600, EPL-N1200 and 1520 printers.

sion process, contained within the printer driver. The new process needs less processing time without loss of print quality.



The four new printers are the Epson Stylus Color 400, 600, 800 and 1520. The 400 is a Windows 3.x/95 only printer and has an RRP of \$499. It has a maximum resolution of 720 x 720dpi on plain paper and a print speed of up to 4ppm (black text). Maximum paper size is A4, software includes system drivers and on-line hints.

The 600 replaces the Epson Stylus



with a maximum print width of 346mm. It prints at 960cps, twice the speed of the Epson Stylus 1500 it replaces. It has an RRP of \$1999.

For further information circle 161 on the reader service coupon, see your local Epson dealer or contact Epson Australia, 70 Gibbes Street, Chatswood 2067; phone (02) 9903 9000. (Internet <http://www.epson.com.au>)



It has a maximum resolution of 1440 x 720dpi (on special paper), and a print speed of 6ppm (black text only). Unlike the 400, the 600 incorporates the super micro dot print head. It comes with printer drivers for Windows and Macintosh (QuickDraw). It has an RRP of \$599.

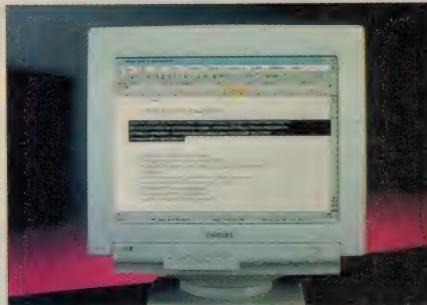
The 800 replaces the Epson Stylus Pro, and has an RRP of \$799. It can print at up to 8ppm (black text) and features network connectivity and optional firmware to provide PostScript emulation. It has an RRP of \$799. Other features are as for the 600. The 1520 is an A2 size colour printer,

...and monitors

Philips has introduced a new series of high resolution colour monitors, in its Brilliance range. The range varies in size from 21" to 15", including the Brilliance 201 CS with CyberScreen technology and the Brilliance 201, 107 and 105.

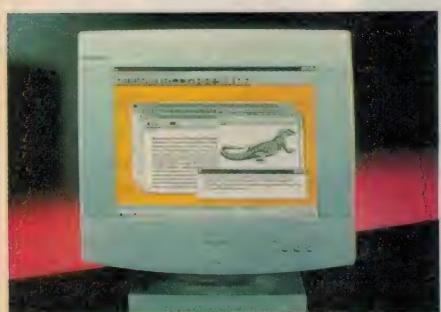
The range offers increased scanning frequencies, and is equipped with Philips proprietary CustoMax interactive monitor software, Colorific software, universal serial bus (USB) and an industrial design with built in front-firing stereo speakers and a 'smiling' microphone. The products are TCO 1995 certified (optional on the Brilliance 107 and 105) and are supplied with power management and power factor correction.

For further information circle 160 on



Clockwise from above: the Philips Brilliance 107B, 104B, 201B, 201, Cyber Screen 201 and 105 monitors.

the reader service coupon or contact Philips Information Products, 3 Figtree Drive, Homebush 2113; phone (02) 1800 658 086.



Adaptors for multiple keyboards and monitors

BJE Enterprises has introduced a range of adaptors which allow two monitors, two keyboards and multiple pointing devices to be connected to the one computer. The devices don't need software or installation inside the computer. There are four products in the range: the Y-Mouse Tablet, which gives simultaneous connection of a graphics tablet and mouse to the same port; Y-Mouse Mouse, for connection of two compatible pointing devices (mouse, trackball etc); Y-Key Key, to connect two keyboards to the one keyboard port; and Y-See Two which connects two monitors to the one computer.

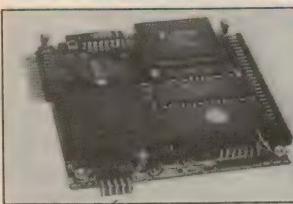
The Y-Mouse and Y-Key adaptors have internal processors to automatically switch to the active device and block the other signal, thereby avoiding conflict. The Y-See Two adaptor boosts the video signal to maintain video quality. RRP is \$89.95 (Y-See Two is \$129.95).

For further information circle 162 on the reader service coupon or contact BJE Enterprises, 124 Rowe Street, Eastwood 2122; phone (02) 9858 5611.

Marine certified computers

Intecolor has released a range of industrial marine-certified computers that complement the company's range of marine-certified monitors. The new systems feature high

Australian Computers & Peripherals from JED... Call for data sheets.



Australia's own
PC/104 computers.

The photo to the left shows the JED PC540 single board computer for embedded scientific and industrial applications. This 3.6" by 3.8" board uses Intel's 80C188EB processor. A second board, the PC541 has

a V50 processor for full XT PC compatibility, with F/Disk, IDE & LPT. Each board has two serial ports (one RS485), a Xilinx gate array with lots of digital I/O, RTC, EEPROM. Program them with the \$179 Pacific C. Both support ROMDOS in FLASH. They cost \$350 to \$450 each.

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This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb. It does it quickly without needing any plug in cards.

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speed Pentium processors, large RAM allocation, high end video, large capacity drives, Ethernet capability, tape deck backup and CD-ROM connections.

They also carry multiple certifications and suit any application where there's vibration, shock, heat and humidity.

For further information circle 163 on the reader service coupon or contact Intelligent Systems Australia, PO Box 118, Berwick 3806; phone (03) 9796 2290. (Internet site at <http://www.intelsys.com.au>)

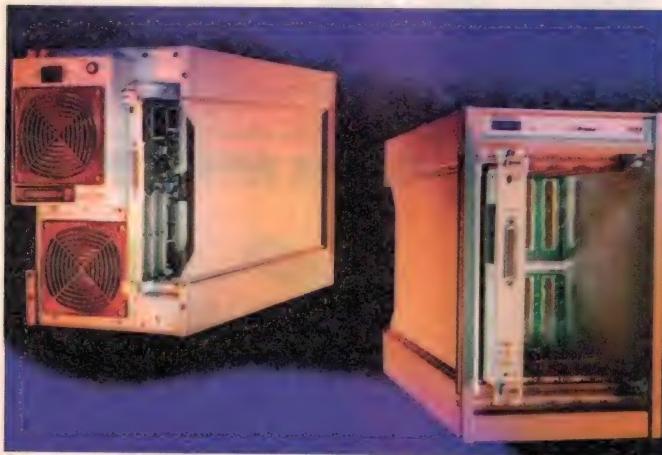
Backplane has nine slots

National Instruments has announced the FlexFrame VXI-1200, a high-power VXI mainframe that can house six C-size and three B-size VXI modules or VME cards for a total of nine useable slots. It measures 355 x 218 x 719mm and provides 720W of useable power. The buses serving C and B-size modules are physically connected and appear as a single bus for seamless communication. Users can configure a Slot 0 interface in the rear of the FlexFrame chassis using a



B-size VXI controller such as the VXI-MXI-2/B.

For further information circle 164 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. (Website at <http://www.natinst.com/>)



National Instruments' Flexframe VXI-1200: a high power, low cost mainframe which can house up to six C-sized and three B-sized VXI modules.

Free DAQ configuration software

National Instruments has announced the availability of the 1997 version of the company's DAQ Designer software configuration utility for Windows NT/95/3.1. DAQ Designer 97 is an interactive package that asks questions about application requirements, such as the quantity and types of signals and sensors, and signal conditioning needs. It analyses the answers and produces a summary report, recommending appropriate solutions including plug-in DAQ boards, signal conditioning products, cable assemblies and the most suitable software for the application. The software is free.

For further information circle 166 on the reader service coupon or contact National Instruments Australia, PO Box 466, Ringwood 3134; phone (03) 9879 5166. (Website at <http://www.natinst.com/>)

Speech recognition software

Voice Perfect has released DragonDictate for Windows V2.52, which now incorporates support for WordPerfect 7.0. According to Steve Freeman, Managing Director: "With the addition of WordPerfect 7.0 voice macros and sentences (used to control WordPerfect 7.0), this new release of DragonDictate is the first speech recognition dictation product to support virtually all Windows and NT applications for PC dictation."

The new version also has several enhancements including an audio setup wizard for Windows 95 and Windows NT, which helps calibrate microphone volume.

For further information circle 165 on the reader service coupon or contact Voice Perfect 36/456 St Kilda Road, Melbourne 3004; phone (03) 9866 6700.

Wide screen palmtop PCs

Hewlett-Packard has announced its new wide screen HP 300LX and HP 320LX palmtop PCs. HP claims the new computers are the only Windows CE-based palmtop PCs with a 640 x 240 pixel, full-width screen that displays information as it would appear on a desktop PC. Other features include the ability to print directly from the palmtop PC, via serial cable or infrared; Pocket Internet Explorer in ROM; and fax receive and send capabilities included with the HP 320LX palmtop PC.

For further information phone the HP Customer Information Centre on 131347. Information about HP products is on the World Wide Web at <http://www.hp.com>. ♦

WEBWATCH

presented by GRAHAM CATTLEY



US Electronics Manufacturers

The US Consumer Electronics Manufacturers Association (CEMA), a sector of the Electronics Industries Association (EIA), has revamped its WWW site as CEMACITY, with home page at <http://www.cemacity.org>.

The homepage has a collection of electronic product icons, each of which links to different area of the site. Areas include the Convention Center, with information on CEMA-sponsored trade shows (Winter CES, CES Mobile Electronics, Spring CES and CES Habitech); CEMACITY Gazette, with CEMA's latest press releases; the Town Hall, with information on CEMA and links to the Web pages of its member firms; and WCEMA, for Real Audio messages from CEMA President Gary Shapiro or spokesperson Jack Wayman. Other multimedia applications are planned. The site is very friendly and has been optimised for Netscape 2.0+ and Internet Explorer 2.0+.

Emona Instruments

Emona's home page (<http://www.emona.com.au>) is well worth a visit; a whole heap of electronically oriented demo software is available, including a preview of the latest version of Electronics Workbench. You can also pick up demo copies of Pico Technology's PicoScope and other circuit simulation and PCB layout software, as well.

While you are there, put your name down for a copy of the ever popular *Emona News* — a bi-monthly publication that reaches almost everyone in the industry. The page also provides users with online technical support and up to date product information.

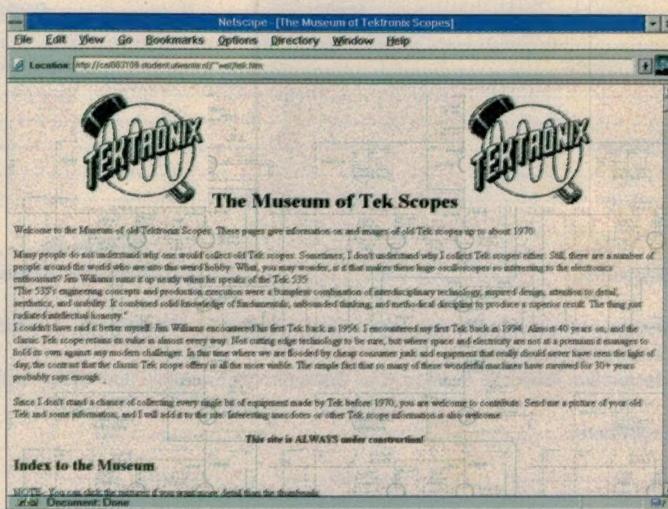
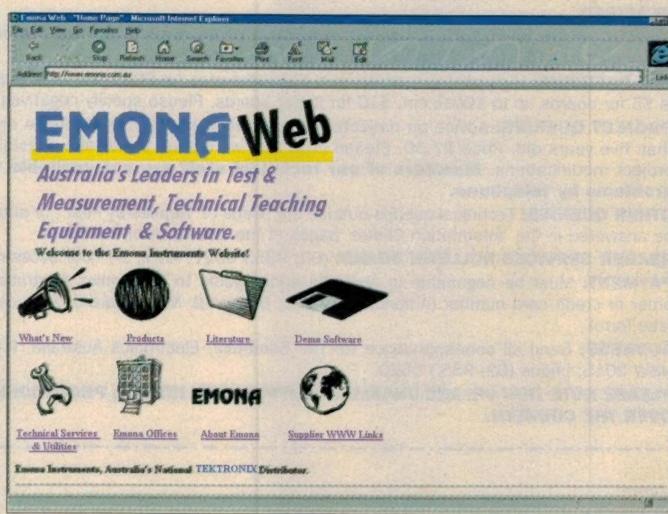
Another item of note is Emona's Web Hot Spots, which take you straight to special products and offers. One current example is Tektronix' 'XYZ's of Oscilloscopes'. This is a comprehensive Windows help file that covers all there is to know about setting up, using and reading almost any type of oscilloscope. At only 501KB, it's well worth downloading.

Scope museum

While still on the subject of oscilloscopes, try pointing your browser at <http://cal003109.student.utwente.nl/~wel/tek.htm>. It's a long URL to type in, but well worth it as this site is a museum of old Tektronix scopes. It contains photos and histories of old (and not so old) Tektronix oscilloscopes, as well info on manuals, tech support for valve Teks and lots more.

The author is obviously an avid Tek scope collector, and he encourages responses from other 'Tek heads', original Tektronix engineers and anyone else with a love of old Tek equipment. This web site also covers many of the Tek range of plug-ins, as well as curve tracers and other pieces of Tek gear, both new and old.

So, if you've never seen a Tek 535, didn't know that the Tek 585A contained four transistors, over 80 valves and weighed 37 kilos, or are just looking for some spares, this site is well worth investigating. ♦



EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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OTHER QUERIES: Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

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SCHOTTKY DIODES

Motorola MBR745 7.5A/45V TO220: \$10 for \$18

CCD CAMERA

Tiny (32x32x27mm) CCD camera, 0.1 lux, IR responsive (works in total dark with IR illumination), connects to any standard video input (eg VCR) or via a modulator to aerial input: \$125. REGULATED 10.4V PLUGPACK to suit: \$11 (Normally \$25)

KITS FOR CCD CAMERA SECURITY

New INTERFACE KIT FOR TIME LAPSE RECORDING: now has relay contact outputs! Can be directly connected to a VCR or via a learning remote control: \$25 for PCB and all on-board components, used PIR to suit: \$12.

■ 32mm 10 LED IR ILLUMINATOR new IR (880nm) LEDs have an output about equal to our old 42 LED IR illuminator: \$18.

■ 32mm AUDIO PREAMPLIFIER An \$8 kit that produces a 'line level' signal from an electret microphone, connect the output to our ■ UHF VIDEO TRANSMITTER (\$30) or \$20 when bought with the camera, for a complete Audio-Video link.

■ 32mm AUDIO AMPLIFIER: An LM380 based \$9 audio power amplifier which can directly drive a speaker — needs the 32mm preamplifier. WHAT IS 32mm? All these boards have a diameter of 32mm so you can house 1 or more of these kits in a plastic 32mm joiner. Inexpensive plumbing part.

SWITCH MODE POWER SUPPLY

Compact (50 x 360 x 380mm), in a perforated metal case, 240V AC in, 12V DC/2A and 5VDC/5A out: \$17

LASER MODULE

Very bright (650nm/5mW) focusable module, suits many industrial applications, ideal for a disco laser light show and with our Automatic Laser Light Show: (L14) \$75

MAY SALE

For three days only we will be offering many items, some of which we've not previously advertised. Some clearance and never to be repeated prices will apply. A complete list will be available at our WEB SITE for three days in May: 9th, 10th, and 11th. Orders accepted only up to the 12th of May. Orders can be picked up at our premises by prior arrangement.

AUTOMATIC LASER LIGHT SHOW

Three motors, mirrors, PCB and component kit. Produces a huge range of amazing patterns: (K83) \$77

KEYCHAIN LASER POINTER

Very bright 650nm/5mW: \$65

COMPUTER CONTROLLED STEPPER MOTOR DRIVER KIT

PCB and components kit plus information and IBM software: (K21) \$35. Kit plus 2 stepper motors (small M17 or large M35) (K21M): \$48

VISIBLE LASER POINTER KIT

Includes 660nm/5mW laser diode, new handheld case, adjustable collimator lens, PCB (58x32mm), battery holder: (K35) \$39

HE-NE LASER TUBE AND SUPPLY

Used 5mW/633nm red helium-neon laser tube and our 12V laser power supply kit. Ideal for light shows. Head size: 380x45mm (I x dia): (L03) \$110

VISIT OUR WEB SITE

Visit our very active (continuously updated) WEB SITE. You will find ■ our complete catalogue ■ kit of the month ■ new releases and product highlights ■ stop press ■ more info on our advertised items ■ ordering information: <http://www.ozemail.com.au/~oatley>

12V - 2.5W SOLAR PANEL KIT

US amorphous glass solar panels with backing glass: (S12) \$22 ea 4 for \$70

INTENSIFIED NIGHT VIEWER KIT

Last chance — slightly blemished 3-stage image intensifier tubes as previously advertised. Comes with power supply and eyepiece. 25mm (NO4) \$220. 40mm (NO5) \$260

DISCO LASER LIGHT SHOW PACK

Used 5mW helium-neon laser tube, 12V Laser Power Supply kit, used Wang power supply and Automatic Laser Light Show Kit: (K83S) \$195

8-CHANNEL IR REMOTE

Add a remote control to anything with this kit. Has a commercial remote control transmitter. Transmitter kit: (K65T) \$20. Receiver: (K65T) \$20

4-CHANNEL RELAY KIT

Ref SC (Circuit Notebook) Aug 95. Kit drives any of four relays according to logic level input signal. Either toggle or momentary operation. LED indicators for each relay, 12V coil, 2A contact rating. (K68) \$30

WIRELESS IR EXTENDER

Converts the output of any IR remote control to UHF. Self-contained transmitter attaches to IR remote. Kit includes two PCBs, all components, 2 plastic boxes, Velcro strap: (K89) \$39. (9V battery not included). Plugpack for Rx (PP10): \$11

WIRED IR REPEATER KIT

Similar to above kit, except transmitter and receiver are joined by a wire. Works with most remote controls: (K66R) \$20

FM TRANSMITTER KIT - MkII

Ref: SC Oct 93. Low cost FM transmitter - 100m range, excellent frequency stability, tuning range 88-108MHz, supply voltage 6-12V. Easy to build, has a prewound coil in a shielded metal can. Includes PCB, all on-board components, electret microphone, 9V battery clip: (K11) \$13

FM TRANSMITTER KIT - Mk III

Range to 200m. Has a pre-wound RF coil and limited deviation, so needs volume to be set higher on receiver. 6V at about 20mA: (K33) \$20

AM LOOP ANTENNA KIT

Ref EA Nov '96. Pull in distant AM stations. Connection to radio via a loop, varactor-tuned antenna (at box near radio). Ideal for remote country areas, caravans, boats etc. 2 x PCBs and all on-board components: (K76) \$29. Suitable box, knob and (HB4) weatherproof mast box: (K76B) \$5 Suitable plugpack: \$13

WOOFER STOPPER Mk II

Works on dogs and most animals, ref SC Feb 96. PCB and all on-board components, transformer, electret mic & horn piezo tweeter: (K77) \$43, extra tweeters (drives 4): \$7 ea Approved 12V plugpack (PP6) \$14 UHF REMOTE TRIGGER Single channel Rx and Tx: (K77T) \$40

LIGHT CHASER KIT

Build a colour ropelight controller, great for discos, shop displays, Christmas decoration. PCB and all on-board components: (K82) \$30 Suitable box: (HB2) \$3.50 12V AC 1A plugpack: (PP9) \$14 7m section of colour ropelight (two in series can be used with one controller): (G50) \$30

PC POCKET SAMPLER KIT

Ref EA Aug '96. Data logger/sampler, connects to a PC parallel port, takes samples over a 0-2V or 0-20V range at intervals from one per hour to one per 100uS. Monitor battery charging, make a 5kHz oscilloscope etc! Kit includes all on-board components, PCB, plastic box and software (3.5" disk): (K90) \$30

KIT OF THE MONTH

We are producing many more exciting kits than the magazines can publish! We will try to release at least one new kit every month and give you a detailed description on our WEB SITE. Just 'click' onto the KIT OF THE MONTH icon on our WEB SITE. Coming: ■ laser beam communicator ■ low cost car alarm ■ laser fence ■ new time lapse interface for CCD camera - VCR security ■ low cost 2-channel UHF remote control with a ready-made transmitter ■ very effective 10 LED IR Illuminator etc.

GEIGER COUNTER KIT

Based on a Russian Geiger tube, has traditional 'click' to indicate each count. Kit includes PCB, all on-board components, speaker and Geiger tube: (K86) \$30

CYCLE - VEHICLE COMPUTER

BRAND NEW SOLAR POWERED MODEL. Intended for bicycles, but can be adapted to any moving vehicle. Could also be used with an old bicycle wheel to measure distances. Top of the range model. Weather and shock resistant. Functions: speedometer, average speed, maximum speed, tripmeter, odometer, auto trip timer, scan, freeze frame memory, clock. Programmable for operation with almost any wheel diameter. LCD readout. Main unit can be unclipped to prevent it being stolen. Weighs only 30g. Max speed reading 160km/h, max odometer reading 9999km. maximum tripmeter reading 999.9km. Dimensions of main unit 64 x 50 x 19mm: (G16) \$40

HIGH POWER NEODYMIUM RARE EARTH MAGNETS

Very strong. You won't be able to separate two of these by pulling them directly apart from each other.

CYLINDRICAL 7 x 3 mm: (G37) \$2.50

CYLINDRICAL 10 x 3 mm: (G38) \$5

TOROIDAL 50mm outer, 35mm inner, 5mm thick: (G39) \$12

ROD 10mm long, 4mm diameter: (G54) \$2.50

IEC LEADS

Heavy duty black 3-core (10A) 3m leads with IEC plug on one end and European plug on the other. \$1.50 each or 10 for \$10

COMBINATION LOCK KIT

Ref SC Sep '95. Keypad combination lock kit based on a dedicated IC. Accepts codes to 12 digits, easily reprogrammed to other codes. Time out feature, three outputs, siren output active after 3 incorrect codes, LED indicators, can be modified for battery backup (K70) \$29

MASTHEAD AMPLIFIER KIT

Our famous MAR-6 based masthead amplifier. 2-section PCB (so power supply section can be indoors) and components kit (K03) \$15. Suitable plugpack (PP2): \$6 Weatherproof box: (HB4) \$2.50. Box for power supply: (HB1) \$2.50 Rabbit-ears antenna (RF2) \$7 (MAR-6 available separately)

LED BRAKE LIGHT INDICATOR KIT

Ref SC Aug '93. Has 60 high intensity LEDs (550 to 1000mC) on two PCBs. Highly visible display equal to or better than those on many late model luxury cars. Each PCB measures 230 x 28mm, takes 250mA at 13.8V (K14) \$25 Another version which can be customised to produce sweep patterns is also available.

SLAVE FLASH TRIGGER

Very simple effective ETI-based design using only a few components. Activates a second flash unit when a master flash unit is activated. Use to fill in shadows and give even lighting. Picks up master flash with a phototransistor and triggers an SCR. PCB 21 x 21mm: (K60) \$9

SOUND ACTIVATED FLASH TRIGGER

Based on ETI project 514. Triggers a flash gun via an SCR when sound level received by an electret microphone exceeds a certain level. Adjustable delay between 5 and 200 milliseconds. LED lights to indicate if sound level is adequate. Take amazing picture like a light bulb breaking. PCB 62 x 40mm: (K61) \$18

MODEL TRAIN CONTROLLER KIT

Ref SC Jul '95. Allows two trains to run on one loop of track without hitting each other. Detects when a train breaks an infrared beam and switches off power to an isolated portion of the track until the other train catches up and breaks another infrared beam at another section of the track. Has relay to switch track sections Main PCB 96 x 66mm, sensing PCBs 59 x 14mm: (K58) \$28

TRAIN SOUND GENERATOR

Ref SC Jul '95. Uses our SG1 COB (chip on board) train noise generator. Has voltage regulator for unregulated 8 to 15V DC operation. Miniature earpiece type 32Ω speaker included. Choose one of four sounds: level crossing bells, steam train whistle, locomotive chuffing, carriage passing over a join in the track. PCB 47 x 39mm: (K59) \$15

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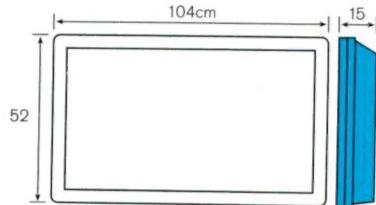


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- Flat panel display with no distortion.
- Completely free from electro-magnetic interference.
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